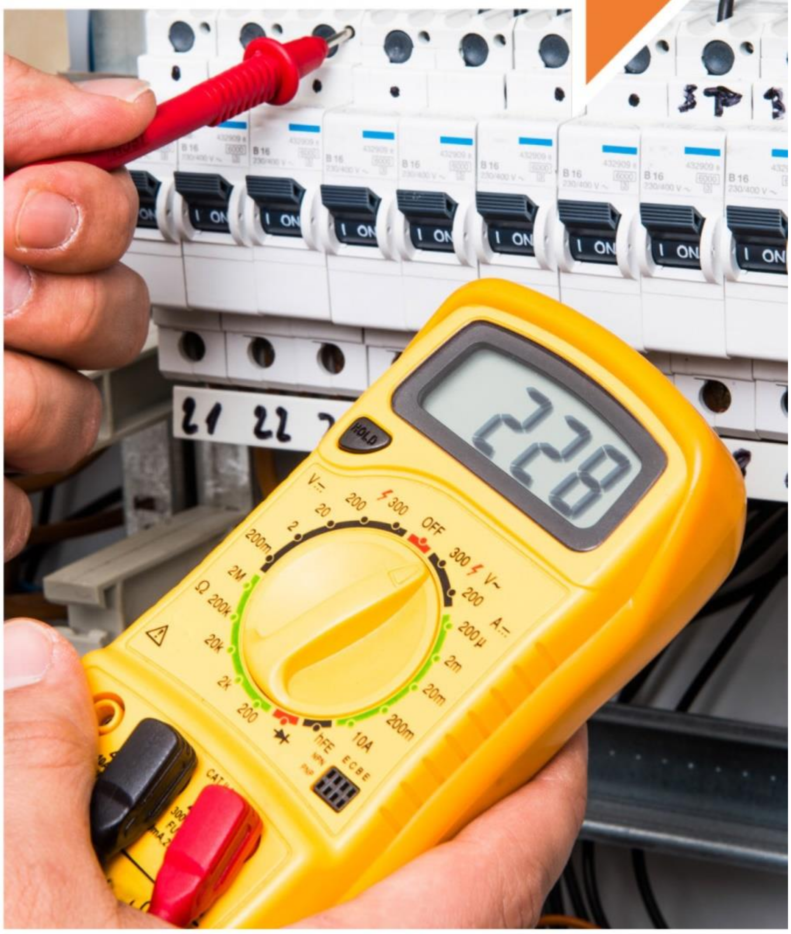
Within 18 Steps
over 3 Stages

to efficient Energy Management according to ISO 50001

A Beginner's Guide



GUTcert
AFNOR Group

Version 5
Status 21.08.2018

- This guide refers to ISO 50001:2018"Energy management systems - requirements with instructions for use". The German wording is based on
- FprEN_ISO_50001, DIN ISO 50003:2014-10 "Energy management systems - Requirements for bodies auditing and certifying energy management systems".
- DIN ISO 50006:2017-04 "Energy management systems - Measurement of EP using energy baselines (EnB) and energy performance indicators (EnPI) - general principles and guidelines".
- ISO 50015:2014-12 "Energy management systems - Measurement and verification of the EP of organisations - General principles and guidance".
- ISO 50047:2016-11"Energy savings - Determination of energy savings in organisations".

It is not intended to replace them and does not claim to be exhaustive. It is available on the Internet at:

https://www.gut-cert.de/service-38/enms-leitfaden-und-tool.html

Text GUTcert, design based on AFNOR groupe.

Suggestions for improvements or information on errors are expressly welcome!
Please send them to info@gut-cert.de.

Prof. Dr.-Ing. Jan Uwe Lieback and the energy team of GUTcert:
Jochen Buser, Yulia Felker, Nico Behrendt, Lukas Wagner

GUT Certifizierungsgesellschaft für
Managementsysteme mbH Ltd.
Umweltgutachter

Eichenstraße 3b
12435 Berlin
Phone: +49 30 2332021-0
Email: info@gut-cert.de

GUTcert is a member of the

afnor GROUPE

11, rue Francis de Pressensé
F - 93571 La Plaine Saint-Denis Cedex
France
www.afnor.org

Preamble

Dear reader,

rising energy prices, political pressure and legal regulations are now making energy saving a top priority. But how is a company able to face up to this task in a meaningful way, without taking time-consuming and expensive detours? How can energy management be set up efficiently alongside the many other tasks that have to be carried out on the side-lines today?

We are a little proud already: For years, our guideline has served numerous organisations as a work aid that enables them to become more aware step by step of how to use energy and to point out potential - and to certainly meet all the requirements of external certification. Based on our many years of experience, we have developed a step-by-step, pragmatic approach that allows all employees to save energy and reduce costs in individual steps.

The guide has been updated over time and adapted to current developments and new experience. In 2009, the second version was published, which integrated the requirements of EN 16001. The third version of our guide incorporates the changes brought in by ISO 50001:2011, whilst the fourth version was developed after the experiences gained from many projects implemented by users of the guide.

Version 5 of our guide is adapted to ISO 50001, which was revised in 2018. Furthermore, the supporting standards/guidelines from the ISO 50000 family (ISO 50003, ISO 50006, ISO 50015 and ISO 50047) have now been taken into account when setting up the energy management system (EnMS).

The aim of an EnMS is to produce more energy efficiently in the long term, to profit economically from it and at the same time to relieve pressures on the environment. The ISO 50001 standard continues to provide excellent support in this respect. However, the standards do not always reflect the sequence of operational processes. For this reason, this guide is intended as an implementation guide.

Another important aspect when introducing an EnMS is its integration into business processes and other existing management systems, such as ISO 9001 (quality management) or ISO 14001 (environmental management). With the revision of the ISO world and a binding or uniform standard structure, the so-called High Level Structure (HLS), this complex task is now also easier to fulfil. Within our guide you will find links to the approach of the integrated management systems.

Start today and reach your goal systematically step by step!

Stage I: Analyse your energy situation and identify potential savings as early as the basic determination stage.

Stage II: Integrate the procedure into your internal processes and make savings systematically.

Stage III: Start your continuous improvement process to constantly increase energy efficiency and cost-effectiveness and easily achieve your ISO 50001 certification capability in parallel!

My tip: read this guide crosswise once to understand the content as a whole and then go your own way to the introduction step by step. Depending on the purpose, size, impact or goal of the organisation, you can stop and linger at each level or take the corresponding steps quickly one after the other and in some cases in parallel.

Once you have reached the third level, you have implemented the requirements of ISO 50001 "incidentally" and safely and can be certified at any time. This would then be the final step in continuously improving energy efficiency, securing additional recognition and, if necessary, state aid. In addition, qualified external energy auditors will help you time and again to find new and exciting ways to save energy.

Good luck in saving your money!

Prof. Dr.-Ing. Jan Uwe Lieback

Table of Contents

What exactly is energy management and an energy management system? ... 6

Stage I – From project idea to assessment status – Identification of initial savings potential ... 10

Step 1: Top Management's Commitment, appointment of project management, analysis of the context ... 10

Step 2: Project scheduling ... 12

Step 4 : Collection of basic data ... 16

Step 5: Energy targets, action plans and savings programme, Verification of success ... 29

Step 6: First management evaluation ... 34

Stage II – Integration of the EnMS into the company processes ... 35

Step 7: Energy policies ... 35

Step 8: Organisational structure ... 36

Step 9: Documented information ... 38

Step 10: Operational planning and control ... 40

Step 11 : Raising Awareness, training and skills development ... 42

Step 12 : Type and structure of communication ... 44

Step 13: Dealing with corrective and improvement measures ... 45

Step 14: Benchmarking and evidence for the improvement of EP ... 47

Stage III – Starting a continuous improvement based on the true PDCA cycle ... 49

Step 15: Application of Organisation and Communication (Do) ... 49

Step 16: Updating the energy analysis, internal energy audits (check) ... 50

Step 17: Annual update of action plans (Plan I) ... 52

Step 18: Management review (Act to Plan II) ... 53

Annex I – HLS as the basic structure of ISO standards ... 55

Annex II – Possible content of Energy Action Plans ... 57

The GUTcert - Who are we? ... 58

EnMS Guide international ... 59

Preface

Energy management systems have been developed in recent years into an effective method for reducing energy consumption and thus energy costs: energy efficiency has been established as a key economic success factor. An organisation's direct and indirect CO_2 emissions, (the so-called "Corporate Carbon Footprint" (CCF)), decrease proportionately with increasing energy efficiency.

Successful certification of all large companies in the European Union (EU) has been a means of ensuring legal compliance with the EU Energy Efficiency Directive, (transposed into national law in Germany with the Energy Services Act (EDL-G)) since 2015. A certified energy management system (EnMS) offers manufacturing industry of particularly energy-intensive companies the possibility of benefiting from tax refunds and being exempted from levies.

Energy management has undergone rapid development in recent years. The first European standard for energy management DIN EN 16001 issued in 2009 quickly gained international recognition whilst the first international standard ISO 50001 was published in June 2011 and has been the globally recognised standard for EnMS. In 2014, ISO 50003 was published, which, in conjunction with ISO/IEC 17021:2015, defines the requirements for competence, consistency and impartiality in auditing and certifying EnMS, thereby standardising the requirements for certification procedures worldwide.

The requirements stated in ISO 50003 are addressed directly to EnMS accredited certification bodies. The requirements of ISO 50001 are specified in ISO 50003: Certification bodies must ensure that auditors confirm the improvement of energy performance (EP) through the audit samples taken during the audit. The prerequisite for issuing or reissuing certificates is therefore confirmation of energy performance by the certification body. ISO 50003 requires that certification bodies examine the improvement of EP in such a way that it can be traced and is recorded in the audit report. This traceability of energy is required through both the (re)certification and the accreditation procedure (defined by the German Accreditation Body DAkkS and other competent authorities). Topics such as "energy indicators", "influencing factors", "normalisation", "adaptation", "measurement and verification plan" have thus become even more important for the individual actors.

Figure 1: Relationship of energy management standards as defined by GUTcert

The ISO 50006 and ISO 50015 standards were developed as guidelines to provide users with further assistance (see Figure 1). This fifth version of the GUTcert guideline also contains tips and instructions, in particular to ensure transparent evidence of continuous improvement of EP referencing the relevant ISO 50000 family standards.

Five years after its original publication, the revision process for ISO 50001:2011 was initiated and the revised standard has been republished (in 2018) following the new paradigm of the ISO world: Since 2012, all new and revised ISO management system standards have been structured according to a uniform content structure, the so-called **High Level Structure (HLS).** This results in the better integration of an EnMS into other management systems within integrated management systems (IMS). Above all, the revised ISO 50001 introduces new topics such as the improved strategic focus of the management system, the systematic assessment of risks and opportunities and implementation of the requirements in the company processes. The improvement of EP will become a "key element" to drive all structures to be created in order to ensure success in terms of energy efficiency on the basis of valid measurements (see Appendix 1). This GUTcert guideline ensures the introduction of a system that withstands certification according to ISO 50001 in every respect and supports an energy audit according to EN 16247-1 or ISO 50002.

What exactly is energy management and an energy management system?

Energy management (EnM) is according to the definition in VDI 4602:2018:

"...the forward-looking, organised and systematic coordination of the procurement, conversion, storage, distribution and application of energy to meet usage requirements, taking into account ecological and economic objectives".

It is designed to reduce energy costs, increase energy efficiency, reduce energy-related environmental pollution, ensure security of supply and at the same time meet customer requirements.

An EnMS provides the necessary resources to firmly anchor the idea of energy efficiency in all processes and among all employees. According to ISO 50001 (terms specific 3.2.2) it includes a:

"A set of coherent and interacting elements of an organisation to define an energy policy, goals, energy goals, action plans and processes for achieving these goals and energy goals."

Similarly to environmental or quality management systems, an EnMS must also be systematically set up in the PDCA cycle (Plan-Do-Check-Act). This enables users to **continuously improve** their EP and the system itself and to provide comprehensive proof of this.

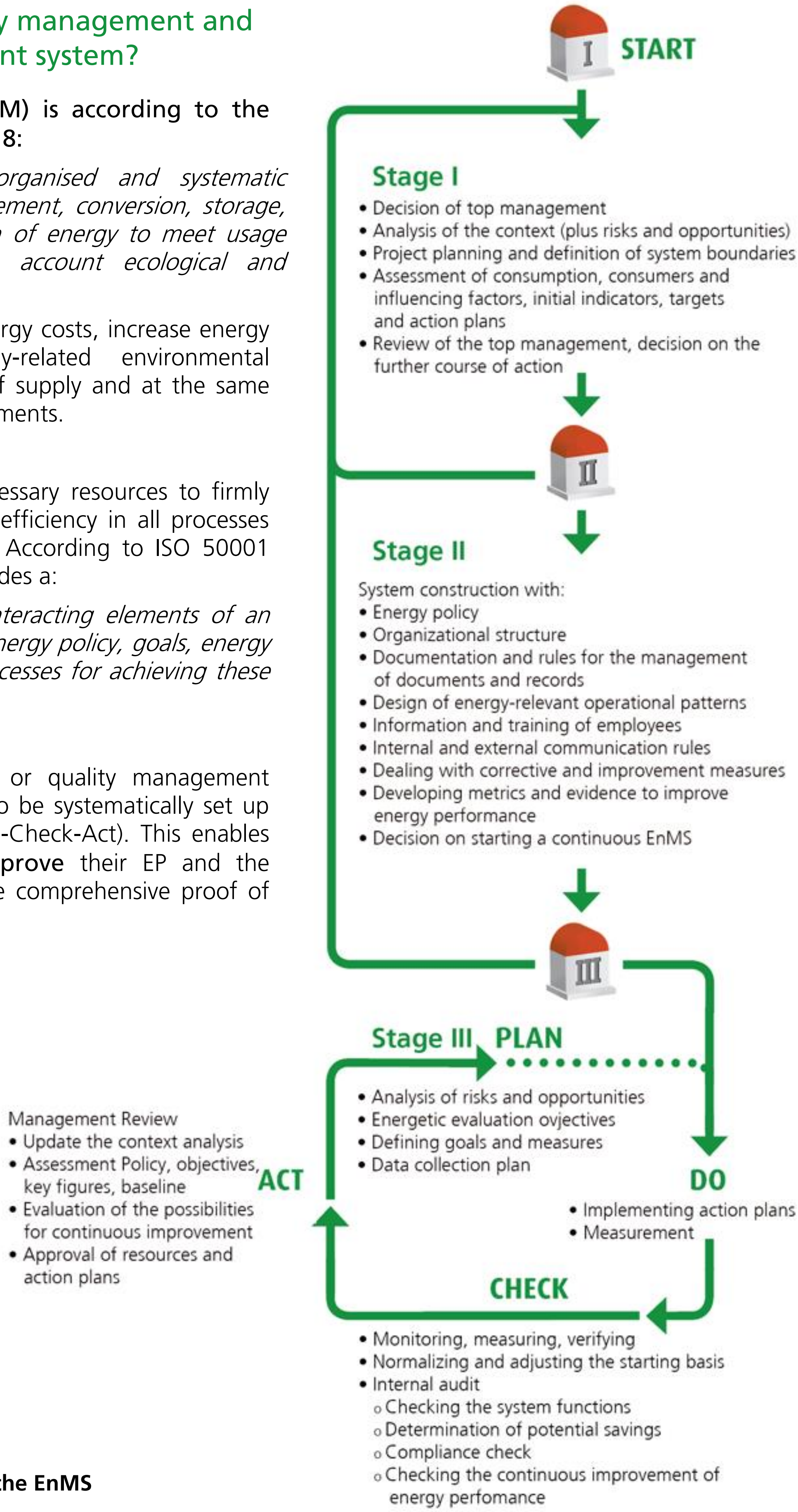


Figure 2: The PDCA cycle in the EnMS

The PDCA cycle in an EnMS context represents an organisation recording its energy flows, identifying the relevant factors influencing consumption, deriving measures from them, systematically monitoring their implementation, continuously receiving information for establishing new goals and measures and checking their applicability within the organisation.

Planning ("plan"): The first step is to understand the business environment, the so-called context of the organisation. Dealing with the interests and requirements of interested parties and accounting for their individual requirements and obligations forms the solid foundation for assessing risks and opportunities that must be taken into account when setting EnMS objectives. On this basis, the following key elements are defined: introducing strategic and operational energy targets (policy), setting of targets relating to savings when taking into account the main energy influencing factors, defining framework action plans including relevant measures and determining responsibilities for them, providing the required resources and defining energy performance indicators and the associated initial energy basis

Execute ("Do"): The creation, maintenance and establishment of management system structures to control and maintain a continuous process to implement improvements. The main focus here is on implementing action plans, controlling energy-relevant operational processes and procedures, securing the competence, awareness of employees and their integration into the EnMS across all functions and levels.

Check: is the self-checking of the EnMS's functionality, targeting progress and gathering new ideas for improvements, (if necessary with the help of external energy and system experts). At the same time: monitoring, measuring and verifying process success introduced in the "Plan" and "Do" sections and measures taken to improve the EP. This includes a summary of current energy data, audit results and more recent insights (new methods and machines/plants), verification of legal conformity and other relevant requirements.

Act: involves reviewing developments in the business context (risks and opportunities), if necessary adjusting the energy strategy (policy), assessing the status quo or progress during the management review, deriving/defining new goals and approving further measures **for continuous improvement** and evaluating the state of the company's compliance with the law and other relevant requirements.

The fundamental basis of all management system standards involves the inclusion of the essential elements of the PDCA cycle. An established and ongoing management system follows this process. To get started, an initial analysis is necessary, which is not described by the ISO standards. This guide therefore deliberately takes a different approach. The first two stages of this guide describe the steps required to structure and define the EnMS whilst Stage III describes the PDCA cycle processes. A background of practical experience gained in recent years, has allowed the introduction and implementation of an efficient system that follows ISO 50001 to be described. This follows 18 **steps** based on operational **practice.** All standard requirements are taken into account, as can be seen from the references to the standard chapters noted in the margins.

For EnMS beginners, this guide offers a clear and practical structure that enables success in achieving energy savings right from the outset without having to create a bureaucratic superstructure. The documentation is generated - efficiently and practically - completely automatically when the introductory steps are worked through.

Ordering the system right from the start

When establishing an energy management **system different** default documents (system descriptions, procedures, rules) and records (protocols, data tables, evaluations) arise which should be systematically ordered right from the start. They form the basis of an EnMS and will support evaluation and planning. In order to provide you with an orderly filing structure from the outset, we have provided a summary of the most important documents that will arise in the course of processing the steps below.

Stage I

- Declaration by Top management (1)
- Context analysis (risks and opportunities) (1)
- Project plan (2)
- Determination of balance sheet limits and scope (3)
- first energy, measurement and verification plan (4)
- Energy report (4)
- Register of legislation (4)
- List of measuring equipment (4)
- Energy data collection plan (5)
- first list of possible energy savings (energy saving programme) and action plans with measures (5)
- Minutes of the 1st Energy Review (6)

Stage II

- Energy policy (7)
- Organisational structure (8)
- Definition of document control (documentation rules) (9)
- Determining the design of energy-related activities (e.g. purchasing of goods and equipment), planning of infrastructure and processes (10)
- Employee training plan (11)
- Specification for communication (12)
- Improvement action plan (13)
- Annual energy planning (14)
- Verification for the improvement of the erP (14)
- Energy, Measurement and Verification Plan (14)
- Energy performance indicators (14)

Stage III

PLAN

- updated energy saving program (17)

DO

- Records from current energy controlling (15)

CHECK

- Internal audit program (16)
- Internal energy audit, audit plan and report (16)

ACT

- Updated energy analysis (and energy report where applicable) (16)
- Logs of Mgt. Reviews (18)

Step-by-step introduction of an energy management system

Usually, larger organisational projects are carried out in stages, after the achievement of which there are always milestones with opportunities for top management to intervene and make decisions.

You should therefore plan the introduction of an EnMS in three essential "self-contained" steps:

I. **Survey of the current status to determine the first saving measures (steps 1-6),**
II. **Introduction of supplementary or new regulations for the management of an organisation(Steps 7-14)**
III. **Comprehensive operation of a management system aligned with the PDCA cycle for continuous improvement (steps 15-18).**

For a fast certification, you can process the three steps quickly and partly in parallel.

Relevant or partial steps for ISO 50001 requirement implementation (Clauses 4-10) are indicated so that, during parallel study of the standard and this guideline, reference can be made as to which requirement of the standard is currently being implemented or on which standard specification is currently being worked on.

Standard chapter

In addition, reference is made to standard clauses from the ISO 50006 (Measuring energy performance using energy baselines (EnB)) and ISO 50015 (measurement & verification) guidelines.

At the end of each stage, the top management must decide whether the next stage is to be undertaken, whether the implementation is to be stopped or whether the work carried out at the end of the stage is to remain permanently. These points are indicated separately by **milestones** that point out that we can only go further once the top management has been fully informed about the results to date and has positioned itself for further action.

In Germany, the EnMS is more attractive for companies due to a legislative basis introduced in 2013 relating to energy management. Additionally to ISO 50001 and the "energy audit" described in the DIN EN 16247-1 standard, an "alternative system" is also approved for small and medium-sized enterprises (SMEs). This essentially consists of carrying out an energy review - similar to that described in ISO 50001 – involving the preparation of action plans and their approval by top management. For those interested in this alternative system, the legal requirements of the Peak Compensation System Ordinance (SpaEfV) are listed in the margin of this guide. You will notice that you already fully meet the requirements of SpaEfV with steps 1-6 of level I of this guide.

§
No. X

Since the EDL-G came into force in March 2015, the service sector is also subject to the obligation. This has prompted us to expand the guide in this respect with the relevant passages being supplemented by texts or special "service graphics". The tables and figures concerned are always clearly labelled. If no distinction is made between industry and service providers, the contents apply to all types of organisations.

Stage I – From project idea to assessment status – Identification of initial savings potential

The process starts by the top management making the decision to introduce an EnMS according to DIN EN ISO 50001 and informing the entire company. This is the first milestone which is reached right at the beginning.

Once the top management has positioned itself, it makes sense to draw up a project plan in which those responsible and involved are defined as well as the time schedule and the goals or interim goals. At this stage, the first analysis of the business context is already necessary in order to determine risks and opportunities: These are essential for further planning. In order to define the project boundaries, it is necessary to define in parallel the balance sheet limits as precisely as possible (including data collection) before the first extensive task is due. The evaluation of the results with top management is carried out and if the decision is to proceed, this will initiate the second stage, and indicate the completion of the first stage.

Step 1: Top Management's Commitment, appointment of project management, analysis of the context

At the beginning, the top management of the organisation must make a clear commitment to understanding the current situation and provide the resources for its implementation. .

5.3

ISO 50001:2018 attaches a special role to top management. The appointment of an energy management officer (ISO 50001:2011) is no longer required in the revised 2018 standard. This is intended to express an increased commitment of the management. However, senior management must ensure that responsibilities and authorities for relevant roles are assigned within an **energy management team** and communicated within the organisation. Therefore, the appointment of a **project manager**, or in other words the **Energy Management Officer (EnO)** in the role of the "doer", still makes sense.

§
§5, paragraph 1, page 3

The EnO must have the necessary resources (time, assistants, IT, if necessary money for measuring equipment, etc.) and must be allowed to appoint persons with sufficient professional competence as members of the energy management team to handle the energy management activities he delegates (see step 8).

4.1-4.4

Another important task is the research and analysis of the context in which the company operates. This consists of a variety **of internal and external topics** that define the scope and content of the EnMS by so-called **interested parties** (also called stakeholders).

a) Interested Parties

4.2

Interested parties (3.1.5) of an organisation in the EnMS are all natural or legal persons who can influence or are affected by a decision or activity regarding the EnMS or **energy performance (EP)** (3.4.3). In specific terms, the following factors can be defined as interested parties:

- Government and Standard organisations, authorities, associations, energy suppliers, consultants, auditors, competitors, suppliers, landlords, insurance companies and financiers **or external stakeholders**
    - The following external issues may be relevant to the EnMS: government or industry-specific targets and agreements; energy supply requirements, restrictions or limitations and security and reliability of supply; geopolitical interests and thus the development of energy costs, the impact of climate change, etc.

- the management, employees, if necessary works council etc. **(or internal parties)**.
  - The relevant internal topics include corporate business goals and strategy, asset management plans, (e.g. asset management systems such as ISO 55001), maturity of the EnMS, technological maturity, and operational risks, Personnel policy.

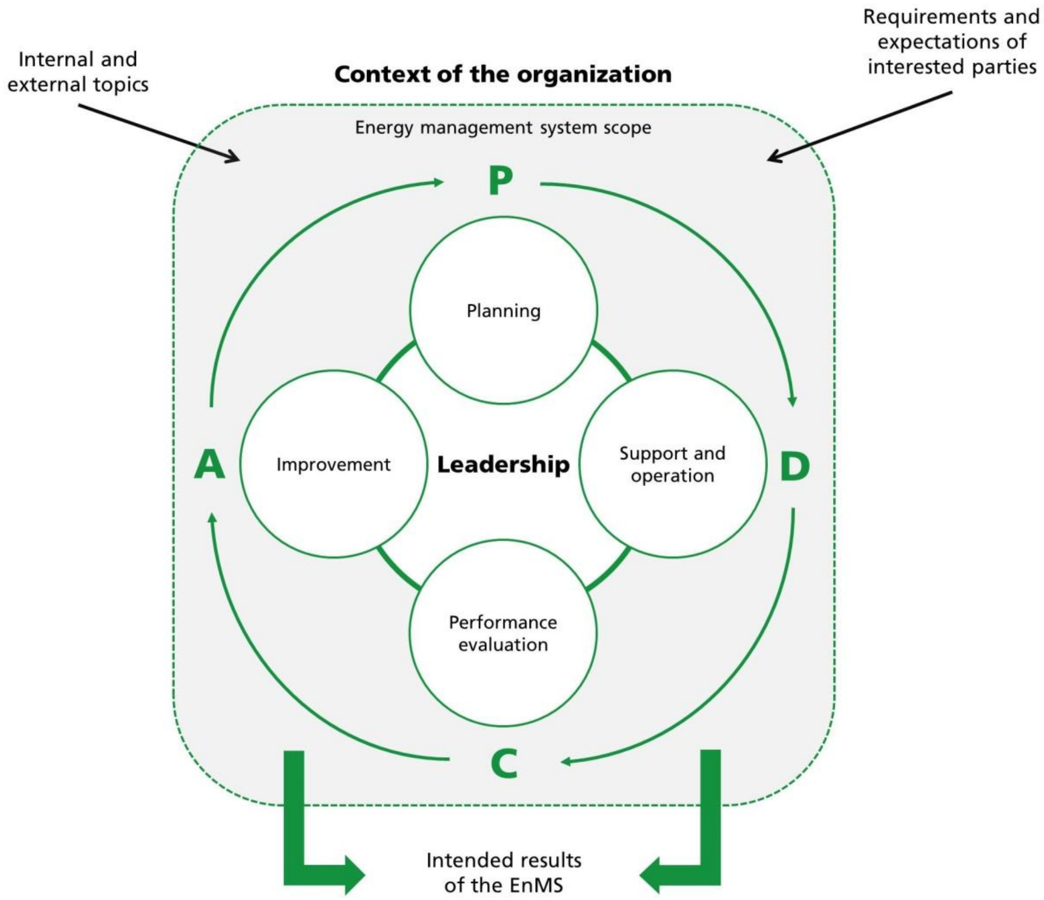


Figure 4: Involvement of stakeholder interests in the EnMS

b) Analysis of risks and opportunities (R&C)

The next step is to summarise, systematise and analyse the insights gained from the stakeholder's requirements and interests. A table matrix, for example, is suitable for this: It facilitates data maintenance and updating.

The results of the analysis show which interested parties have the greatest influence on the EnMS, on the company's EP and which topics emerge as the most important. These topics are evaluated from a **risk** (3.4.11) and (unconditionally!) **opportunity** perspective. The methodology for assessing risks and opportunities (R&C) should be **defined** and **comprehensibly documented** as part of the planning process to enable continuous updates. 6.1-6.2

Practical tip: Essential criteria for evaluation are EnMS (4.2) related **legal and other relevant obligations**, approval conditions, rental contracts, industry agreements, energy-relevant technological rules, guidelines and standards etc. (Step 4).

Step 2: Project scheduling

Tracking the next steps is facilitated by drawing up a project plan. It helps to plan and coordinate activities and resources. It can also be used to derive the timeframe that is required or should be made available for the introduction of an EnMS.

Experience has shown that project planning leads to a greater focus on the goals to be achieved and guarantees better planning through the setting of deadlines. Use existing tools for planning and controlling projects. These make it easier for you to achieve goals as planned and to keep track of completed and outstanding project steps.

The time required to introduce an EnMS will vary depending on the company's specifications, size and complexity. This is based on the provision of resources, the Top management's commitment as well as the management's ability to manage energy.

In practice, EnMS are actually introduced within a timeframe of 3 to 18 months. Our experience shows that 6 months is challenging but feasible. The implementation time can be shortened with the support of an external consultant.

The minimum time required to introduce an EnMS:

small companies (up to 50 employees) at one location

- with existing management system: implementation duration approx. **2 to 4 months**
- without existing management system: implementation duration approx. **3 to 6 months**

medium-sized companies (from 50 to 500 employees) at one location

- with existing management system: duration of implementation approx. **3 to 6 months**
- without existing management system: implementation duration approx. **6 to 12 months**

Large companies (from 500 employees) at one location

- with existing management system: duration of implementation approx. **4 to 8 months**
- without existing management system: duration of implementation approx. **6 to 18 months**

If **several locations are included, an additional 2-4 months are to** be planned (data based on experience).

Table 1: Experience values for the time required to implement an EnMS

Tip for SMEs:

For the presentation of the plan, instruments should be used that the company already uses or is aware of.

For example: Microsoft Excel and Microsoft Project or simple control software for projects, also available as freeware.

Step 3: Determination of balance sheet limits

Project planning should include setting the scope boundaries and carrying out an initial energy review. 4.3

An energy accounting framework is crucial for determining the scope and the complexity of the EnMS (ISO 50006, 4.2.2).

Here too, the requirements and interests of relevant stakeholders must be taken into account: For example, a high-voltage switchgear upstream of the plant connection, supply or delivery traffic or the production of externally manufactured assemblies can be excluded or included according to the influence on energy consumption or the possibility of influencing it.

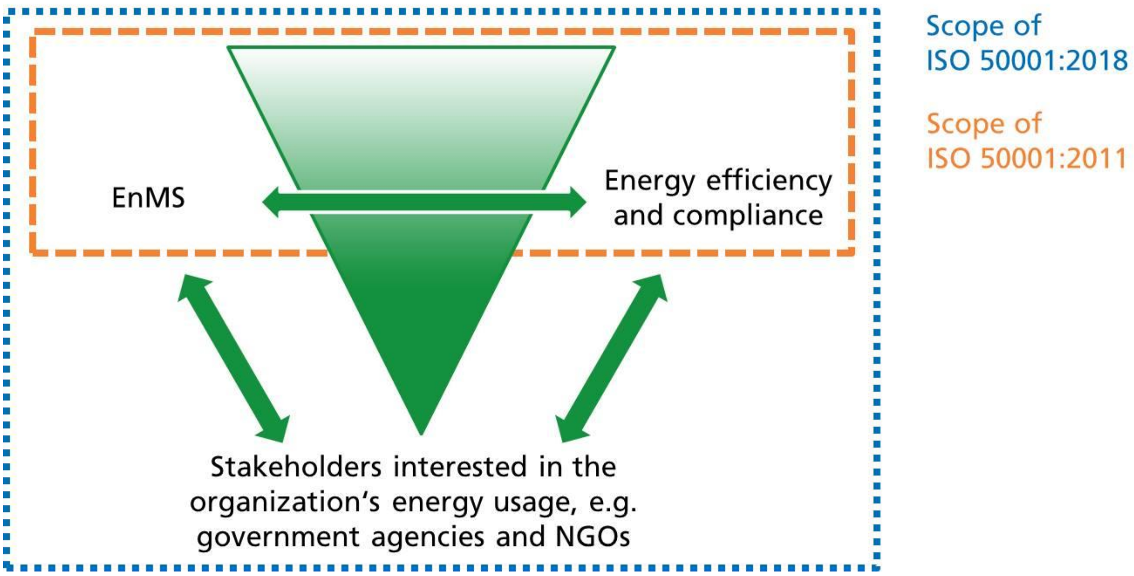


Figure 5: Triangle of interests and scope

ISO 50003 does not allow the exclusion of any energy sources. Defining the balance sheet limits is the energy representative's first task parallel to create the project plan. The balance limits should make it possible to allocate 100% of the energy consumption to the sum of energy consumers. This includes the energy components (electricity, gas, oil, heat, etc.) and the total energy used. It should be noted that energy in the system can be converted, "lost" due to efficiency losses or it may leave the system as diffuse heat radiation (see 1. main theorem of thermodynamics). In order to measure EP, appropriate measurement limits for energy performance indicators should be clearly defined from the outset so that they are appropriate for the relevant significant energy consumption.

Setting the boundaries is process-related, systemic (spatially or on the basis of logically related processes) or organisational (ISO 50006, 4.2.2). In this context, it is also important to identify the users of the key figures and their needs (ISO 50006, 4.3.2).

Note: What "energy" considered in energy management?

Direct use of energy through:

- Combustion of coke?/ coal, gas, oil or substitutes
- Use of e.g. diesel in vehicle fleet or for internal transport
- Industrial gases which have a chemical-caloric energy input (and possibly additional energy input due to their upstream pressure)

Also to be included:

- already refined energies such as electricity, steam, district heating, cooling or compressed air, which are procured outside the balance sheet framework
- energy, such as electricity, steam, heat, cooling water or compressed air, which is refined within the limits of the balance sheet

In addition, the release of energy to the outside world beyond the balance sheet limit must also be considered:

- e.g. as flammable CO gas
- as a product for a neighbour (e.g. steam, district heating or electricity)
- as energetically recyclable residual material (e.g. wood dust, wood chips, pellets etc.)
- as waste heat in the cooling water, as radiant heat or diffuse as warm air

Also important for the overall analysis is the high physical energy content of the supplied compressed gases, e.g. nitrogen, oxygen, argon, acetylene or hydrogen - whether used energetically or not! In addition to their physical energy content, technical gases may also provide a chemical energy content. The diversity of the industry requires individual analysis.

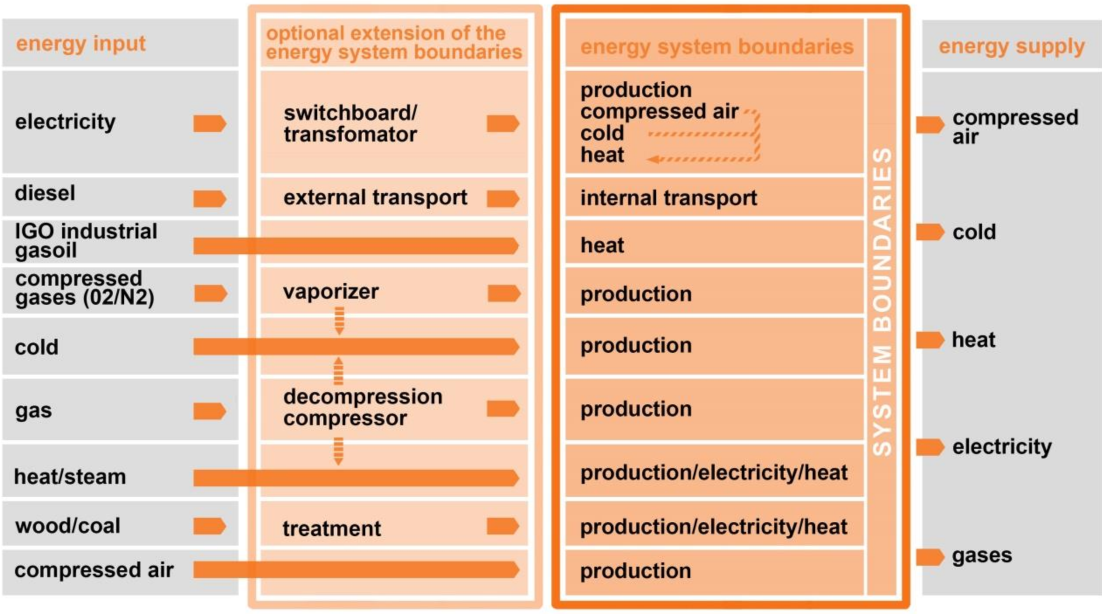


Figure 6: Determination of the balance sheet limit for industry

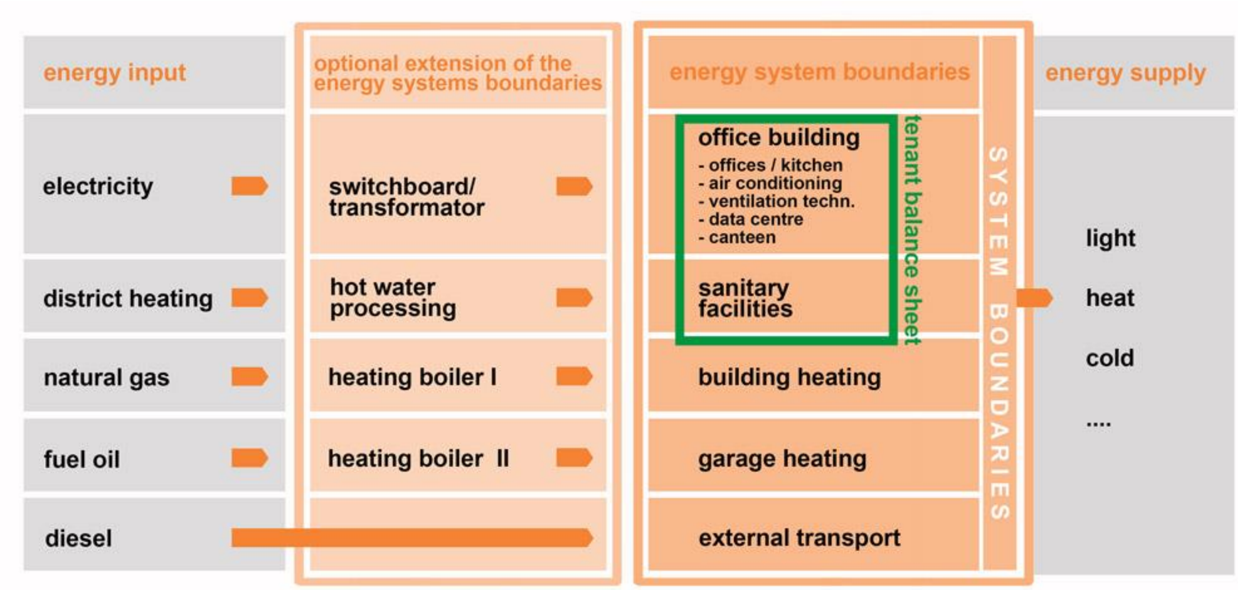


Figure 6.1: Determining the balance sheet limit for service providers

Note: In addition to the (balance) limits of the EnMS, ISO 50001 refers to its scope and application. Balance sheet limits must be understood in terms of location and relate to facilities and energy flows. The terms scope and application of an EnMS are used synonymously in the standard. They describe the scope of the activities, locations, processes, facilities and decisions to which the EnMS applies. The terms scope or application area therefore represent the sum of several boundaries: e.g. a head office with several locations and, if necessary, points of use (not permanently staffed) with their own balance sheet boundaries and an overall balance sheet for the company (e.g. incl. transports between locations).

Limiting the scope to parts of the company or individual activities is possible in other management systems, but is hardly an option with the EnMS, since energy flows can rarely be meaningfully defined.

In particular, all company locations (including warehouse and administrative locations) must be included if tax relief is to be taken advantage of.

The energy consumption of the company that uses the building or premises for operational purposes and in this context obtains and consumes final energy must be taken into account (This is especially the case for service providers who often use rented buildings or premises). For this purpose, the balance sheet framework for the tenant must be established. The building envelope as well as the heating, cooling, room air and lighting systems and equipment for which the company is not responsible and therefore has no direct influence on energy consumption can be exempt from inspection. However, it can be advantageous to assess these systems in terms of energy efficiency and, if necessary, to convince the landlord of the need to invest in the energy efficiency of the building and the above-mentioned systems.

Tip for tenants:

In principle, you have the right to request the energy certificate for the office building from your landlord. This enables you to track energy consumption/energy efficiency and compare it with other properties when choosing a rental property.

Step 4: Collection of basic data

The next step is the **first data collection**, which involves the systematic recording of the current status. This energy starting point is an essential basis of the EnMS, since all planning and goals are based on it. It is the reference point for future comparisons EP (ISO 50006, 4.1.6). The energy starting point always refers to a fixed period (usually one year, possibly divided into months). The evaluation of the baseline should include external factors as a standard reference.

6.3

§

§5, paragraph 1, page 3/ Annex 2, No. 1

The **energy evaluation (3.5.5)** is the most important part of the basic data collection. Energy input and energy consumption should be recorded in detail and preferably for several years in order to eliminate one-off effects. The energy analysis also includes the comparison of the recorded figures with selected benchmarks.

The first data collection also includes the analysis of the existing **energy organisation** and the comparison of the organisation with other management systems (e.g. for Quality Management and Environmental Management). In addition, a comparison of current activities and procedures with all **legal and other requirements regarding energy use, energy consumption and energy efficiency** must be carried out (ISO 50001, 4.2). This forms an interface to the R&C analysis (steps 1 and 4).

These detailed entries can be made in parallel to save time. They hardly influence each other. In the end, however, they must be summarised, e.g. as a so-called "energy report".

Hint:

For later evaluation and classification of the results, it is recommended to record some influencing parameters at the same time:

- medium and long-term trends in energy prices
- foreseeable legal regulations
- Development of new economical processes
- Known key figures used
- existing benchmarks etc.

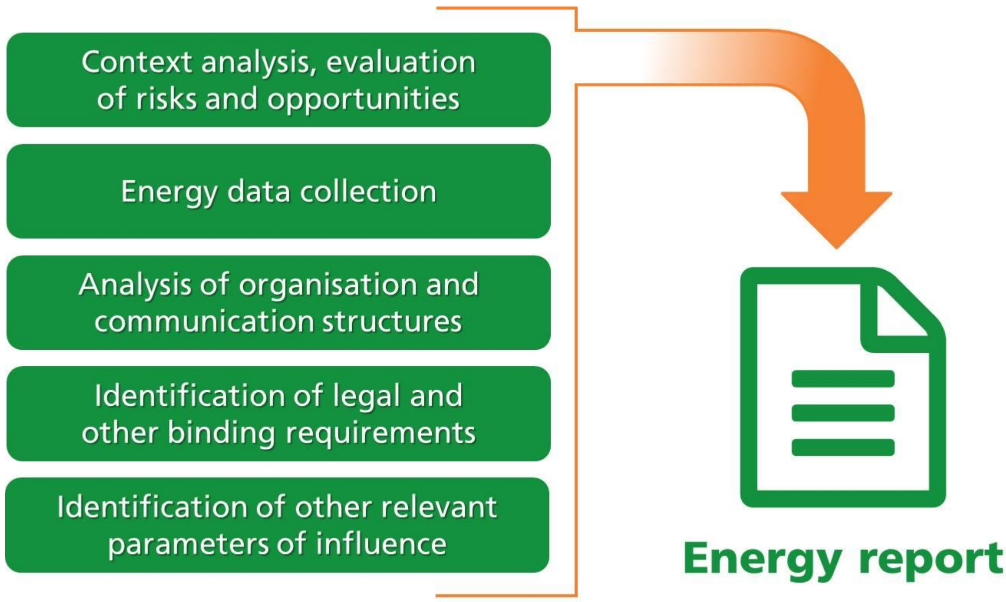


Figure 7: Components of an initial energy report

4.1 Energy evaluation

The **determination of energy status is** of importance in the decision making process at the beginning of implementing an EnMS. This is a comprehensive initial survey which forms the basis for all subsequent planning and decisions. It is systematically updated, usually annually, to review the cycles of continuous improvement (see also step 16).

6.3

It is advisable to record all energy-relevant data for analysis and evaluation in two directories (tables) for each period (annually) - on the one hand for energy consumption and on the other hand for **energy use**. These tables together form the **energy balance** within the defined framework.

a) Energy usage

The analysis begins with the recording and evaluation of the energy used at the site (or for the entire organisation including the points of energy consumption). Consumption should be calculated according to the balance sheet framework for at least the last three years if possible. To identify seasonal effects, it is advisable to record monthly data, if available. Data for energy consumption is usually available from utility bills or purchasing documents and is easy to enter. The data should be broken down as far as possible (monthly, process- and plant-related, building-related, etc.), as potential energy saving may already be visible here. Companies with high energy consumption can request a load curve with quarter-hourly consumption values from their network operator.

6.3a)

§ Annex 2 No. 1

Month	Pow-er[kWh]	Gas[kWh]	Die-sel[kWh]	Coal[kWh]	Oth-er[kWh]	Total ener-gy[kWh]	Produc-tion[t]	Total energy/ t Production
Jan.								
….								
Dec.								
∑ Year								

Table 2: Example of the recording of annual and energy consumption for industry

Month	Torrent			Gas			Other			Total energy			Used area	EnPI
	kWh	€	tCO 2	kWh	€	tCO 2	kWh	€	tCO 2	kWh	€	tCO 2	m2	kWh/m2
Branch A														
Jan.														
….														
Dec.														
Branch B														
Jan.														
….														
Dec.														
∑ Year														

Table 2.1: Example of recording annual and energy consumption for service providers/ chain stores

The energy consumption of a store within a network (chain) should be recorded separately for the individual store with the aim of bringing transparency to the consumption behaviour of each individual store. A later benchmarking is elementary, in which similar locations are regularly compared as in the case of chain stores In this way, it is possible to identify stores with consumption problems, search for specific causes of variances and correct them if necessary.

Since the generation or consumption of energy causes different environmental impacts (key figure CO_2 emissions), it is proposed to also determine the direct CO_2 emissions[1] from combustion processes and the so-called indirect CO_2 emissions from electricity, heat generation or similar processes. CO_2 data acquisition makes it possible to design energy savings in an environmentally friendly manner.

§ Annex 2 No. 1

GUTcert provides a free online downloadable energy tool that supports you in recording the energy sources used and their use by various consumers (https://www.gut-cert.de/service-38/enms-leitfaden-und-tool.html).

eingesetzte Energie/ Energieträger	Bezugsmenge [kWh/a]	Kosten pro kWh [€/ kWh]	Anteil am Gesamt-verbrauch	Kosten [€]	Kosten-anteil	CO_2 Emissionen [t]	CO_2-Anteil	Messsystem oder alternative Art der Erfassung und Analyse	Grad der Genauigkeit/ Kalibrierung
Diesel	280.156	0,11	3,08%	30.817 €	4,31%	74,73	2,49%	Zapfsäule	<2%
Heizöl EL	6.852.681	0,06	75,44%	411.161 €	57,50%	1.827,87	60,91%	Peilstab/Messung Tankwagen	<5%
Strom	1.950.627	0,14	21,47%	273.088 €	38,19%	1.098,20	36,60%	geeichter Zähler EVU	<2%
Summe	**9.083.464,00**		**100,00%**	**715.065,80 €**	**100,00%**	**3.000,81**	**100,00%**		

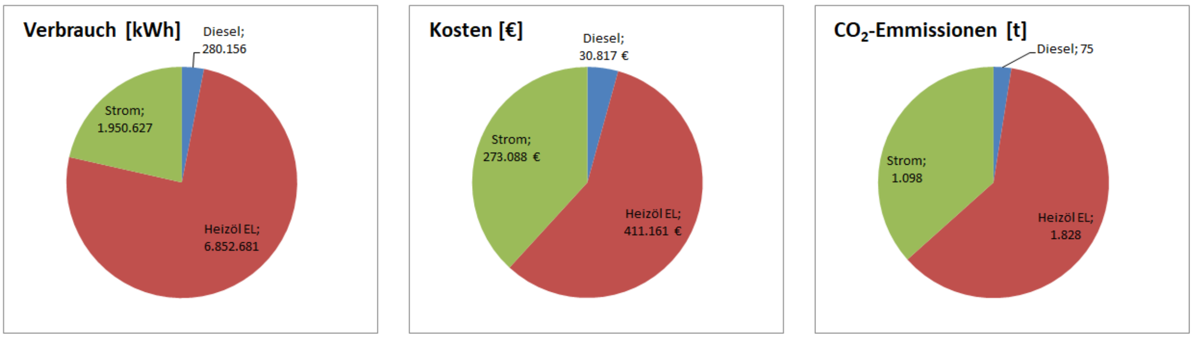


Figure 8: Extract from GUTcert Energy Tool 2.1, initial balance sheet (German)

b) Energy use and consumption

In addition to energy consumption, the energy balance also includes the use of energy. Energy consumption shall be broken down by consumer.

6.3a) b)

A **consumer** can be a unit (motor/melting furnace), a plant section (robot/ roll mill), a complete plant (production line/ cold roll), a process (heat treatment/ mechanical processing), a consumption group (hall lighting) or an entire consumption area including the ancillary systems (administration building) but depends on the organisation, complexity and differentiability of the measurement. Energy consumption progress should be recorded continuously and result in a 100% allocation of the energy input to the consumption. It is important that the subdivision is so small that "energy guzzlers" are detected.

In the consumer directory, the data should be recorded separately for different energy sources used at a point of consumption (electricity, compressed air, cold water, gas, etc.) and as a sum. Care must be taken to ensure that energies generated internally by calculation / conversion (electricity for compressed air generation / compressed air, gas for heat supply / heating water,

[1] emissions are calculated: $CO2_{emissions}$ = energy consumption[kWh]/[GJ] * Emission factor (for grid-bound energies see utility billing or UNFCC standard values, for other forms of energy standard values UNFCC etc.)

etc.) are not counted twice for balancing the individual energy sources (electricity input and consumption) and the total energy consumption. When energy data is registered, any transmissions must be deducted and only own productions (e.g. solar) must be taken into consideration.

The data should be presented as quantities of "consumed energy" (in kWh or MWh), in costs, CO_2 emissions resulting from energy use (direct and indirect), in absolute and proportional terms. This enables detailed evaluations (see Table 3).

Consumer of Energy				Energy used E1, E2, [kWh/€/ $_{CO2/\%}$]				Waste heat[kWh] (tempera-ture level)	Measur-ing system/ meas-urement type	
No.	Attach-ment/ Part	Year of manu-facture	Power consump-tion[kW] (capacity)	E1	E2	E3	Σ			

Table 3: Example for the period-related (annual) recording of energy consumers

Energy balancing also provides information describing the special features of consumers and essential framework conditions. They are later required for period comparisons (operating times, performance indicators, heat output, production figures, illuminated or heated area, etc.). When operating an EnMS, additional data and information may be added later. We therefore recommend that you use a database solution to record consumption data. Depending on the complexity and quantity of the measuring points, tables with a folder structure (cf. example "GUTcert's energy recording tool") may also be sufficient. Different viewing levels of the same consumers have proven themselves effective and facilitate the subsequent creation of energy flow diagrams, e.g. as **Sankey diagrams.**

§
Annex 2
No. 2

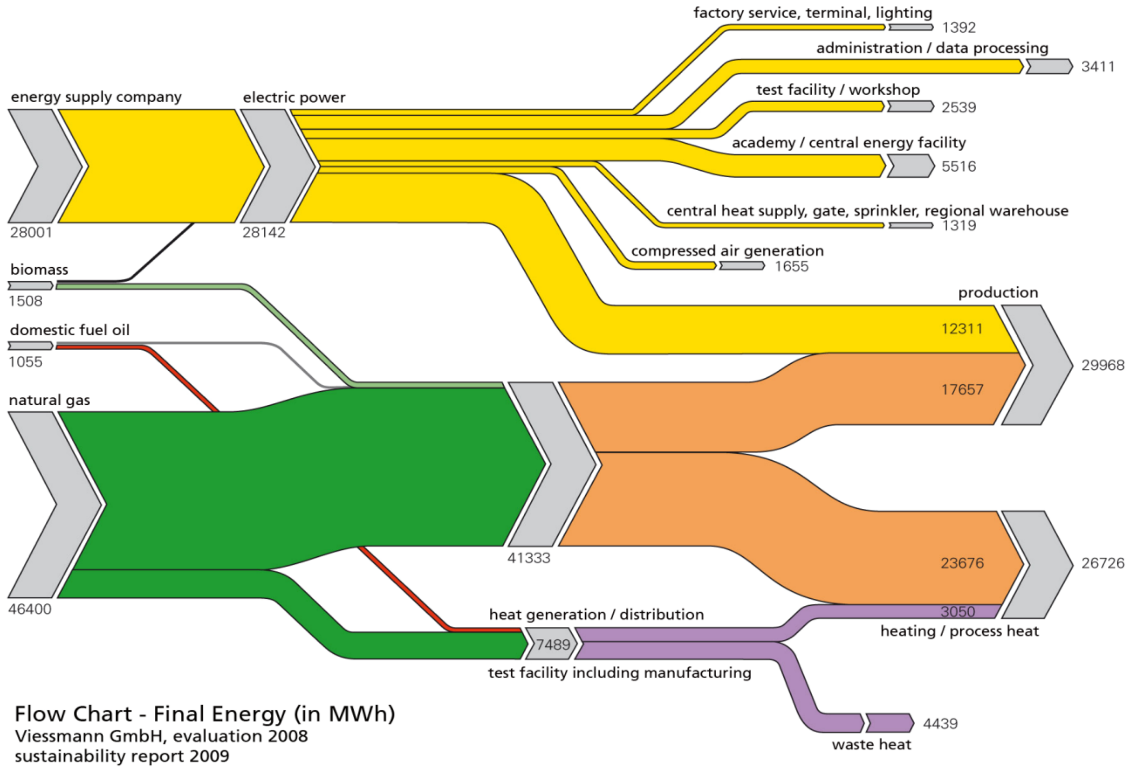


Figure 9: Example of a graphical energy flow diagram for industry

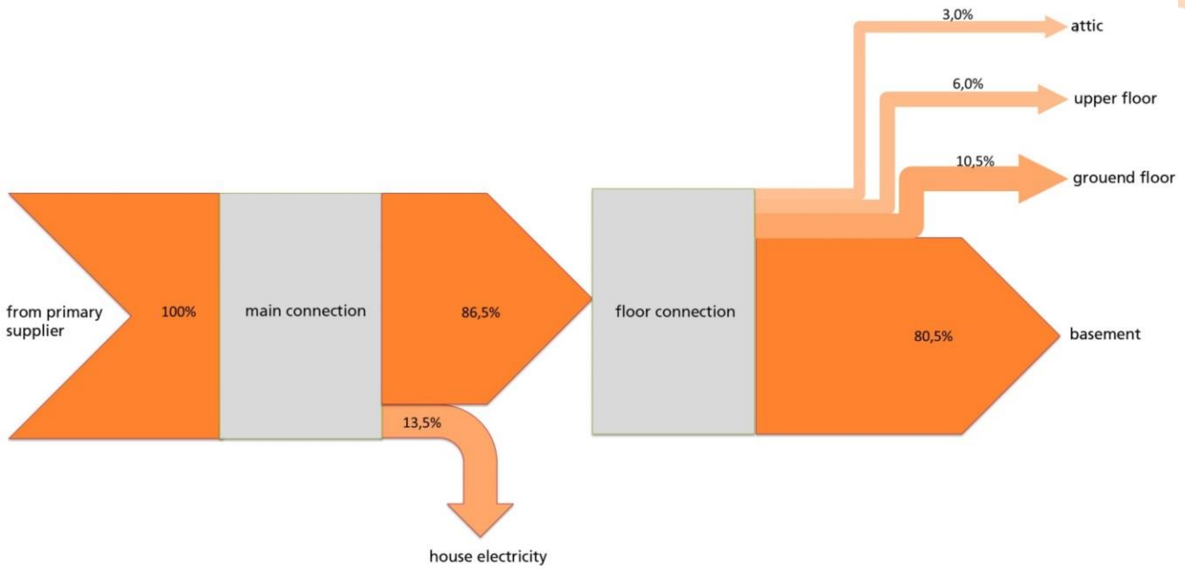


Figure 9.1: Example of a graphical energy flow diagram for service providers

c) Areas with significant energy consumption

6.3a) -e)

An area with a **significant influence on the energy balance** can be a large individual consumer as well as connected plants, equipment, systems and processes that have a significant influence on energy use and **energy** consumption. To determine these, a **methodology** should be **developed and documented.** The planning of optimization measures is based on the relevant significant energy consumers.

During the inventory process and the accompanying measurements, other **general conditions** should also be observed and, if necessary, measured and (unconditionally) **documented**. This refers to external variables that have a significant impact on consumption - positive or negative. They are called **influencing factors** in the EnMS. Examples include climatic conditions, maintenance intervals, break and shift regulations, utilisation of machinery, energy prices, legal framework conditions, production methods, etc. A distinction should be made between significant impacts and those that have little influence on the EP (ISO 50006, 4.2.4). The systematic evaluation of influencing factors is an essential element of the EnMS. It is used to filter out systems and variables that have the greatest impact on energy consumption and so should be a centre of focus in the process.

Tip for service providers:

In order to get an initial overview of building's the energy consumption, the billed energy consumption (electricity, heating energy) and the energy supply contracts must first be checked. In the event of a higher purchase of electricity or gas (special tariffs), power meters for the respective points of purchase are also installed by the energy supply company (EVU), usually from 100,000 kWh (electricity) and from 1,500,000 KWh (gas) upwards. These companies can order their load profile from the energy supply company

Consumption is billed to the energy supply company by means of an "energy price" (actual energy purchased at high and low tariff times) and a "performance price". The service price is based on the maximum consumption within a quarter of an hour (peak consumption). It makes sense to examine the load profile (the load curve): If the maximum power is exceeded, the consumption costs increase, if the power price is set too high for safety reasons, an excessively high power tariff is paid monthly.

To check the plausibility of the load curve, the data from the previous year can be requested from the energy supplier and compared with that of the current year. In context of controlling energy consumption the current values need to be examined thoroughly and graphic presentation can also be forwarded to subtenants.

d) Identifying and determining key influencing factors

6.3c)

§ Annex 2 No. 1

Influencing factors can be of different types. **Routine** changes such as production output, outdoor temperature, availability of daylight etc. are **relevant variables** (3.4.9). On the other hand, when it comes to **non-routine** variables in general conditions such as a significantly changed product mix, renewal of technical equipment or building fabric, **are referred to as static factors and need to be considered.** These have an impact on the exact definition of the actual status and the evaluation progress within the EnMS, so they should be taken into account and adjusted when evaluating the measured values of relevant systems.

Such a clean-up can take place in two steps. **First of all**, these factors are **qualitatively determined**, for example, in a brainstorming session of competent employees. A list of consumers, which can be sorted according to their size (ascending or descending), is helpful for this. **Significant energy consumers** need to be considered more closely. In addition to the largest, these include those with the most fluctuating consumption and those for which changes can be made at short notice and with little effort. In addition, other factors influencing consumption (example Table 4) must be recorded. These are evaluated using criteria that are important for the organisation.

▶ consumption level	▶ legal compliance
▶ Deviation from planned consumption	▶ Degree of environmental pollution
▶ cost-effectiveness	▶ Implementation time
▶ potential saving	▶ Deviation from benchmarks
▶ Influencing factors : technical or organisational	▶ Size of consumption fluctuation
	▶ …

Table 4: Typical criteria for qualitative evaluation of the influencing factors

Example: A qualitative analysis using a matrix representation is often helpful. All **energy influencing factors** are applied vertically and all criteria horizontally. If the criteria have a strong influence, this can be indicated by numbers, dots or colours (strong, medium, low to none). Each matrix field should be evaluated. The energy influencing factors with the highest score or sum are the main ones. Particularly influential criteria, e.g. compliance status, are highlighted by this weighting.

All consumers and factors are compared with some important criteria (consumption/influence, compliance, savings potential) and the most important consumers are evaluated according to all criteria. For service providers, for whom energy consumption results mainly consist of the use of office buildings, user behaviour should be the significant focus area (e.g. office occupancy and times of use, room temperature, air exchange, lighting, stand-by consumption). In addition to the factors mentioned above, humans sometimes have a considerable influence on the energy consumption of a process). Therefore, for each essential consumer it is necessary to analyse which persons influence it and with what relevance.

The physical optimum can be understood in energy management as the ultimate, unbeatable baseline. The optimal operation of a process is that without human and external influences and therefore only dependent on physical laws, described by "the best operation mode ever").

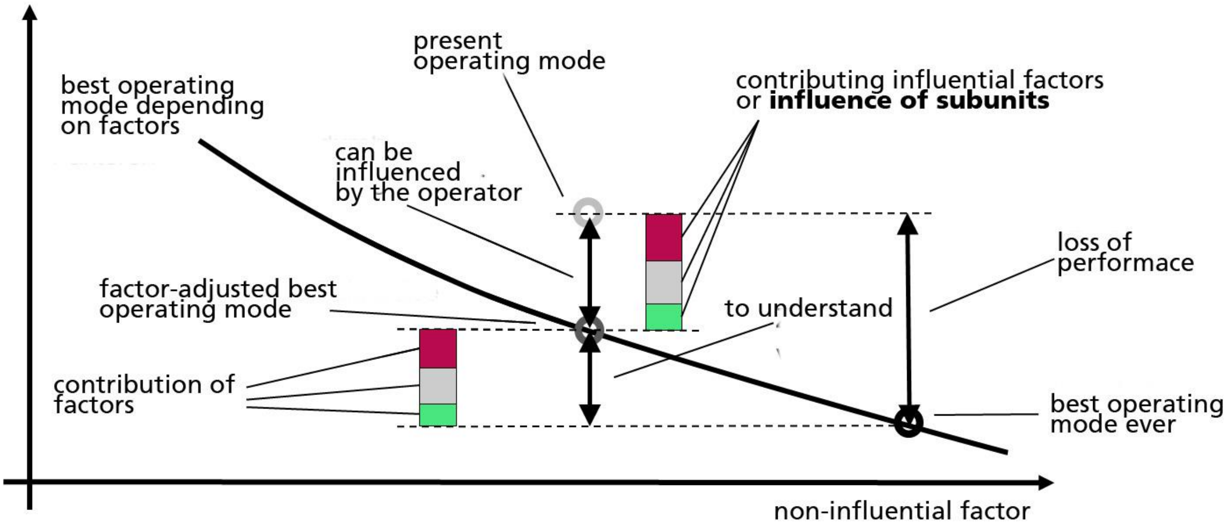


Figure 10: Operating states of a process up to the physical optimum[2]

Once the essential influencing factors for the significant energy consumers have been identified, a second stage begins - a mathematical adjustment. If there are too many possible influencing factors, the influence of each individual factor on energy consumption should be investigated mathematically. The same procedure can be used as for standardising (3.4.10) the **energy starting point** (3.4.7).

e) Measurement and monitoring

The organisation should (according to the standard) above all, measure its essential energy consumers (or main characteristics), **determine** and **document** the methods for monitoring, measuring, analysis and evaluation accordingly. At this stage it is advisable to draw up a so-called **energy data acquisition plan** (6.6), in which all the main principles and methods for the **measurement** (3.4.1) and future monitoring or **verification** are defined. 6.6 9.1

This also includes dealing with the influencing factors or the frequency of measurements, the responsibilities, restrictions and the measuring instruments to be used (including the type of sensor to be used for measuring each individual variable (see also ISO 50015, 5.9)). At the end of the measurement period, 100% of energy consumption should be allocated to a specific application.

Measuring devices and their accuracy must be recorded for specific consumers in order to be able to detect gaps or incorrect values, if necessary. Basically, the measurement accuracy should increase with consumer size. The deviation in recording the total energy flows, i.e. the consumption which cannot be clearly allocated to the consumers, should initially amount to a maximum of 5-10%. This is the only way to ensure that the evaluations have the necessary informative value to set comprehensible goals.

[2] Stefan Krämer, Sebastian Engell (Authors and Editors): Resource Efficiency of Processing Plants: Monitoring and Improvement, page 99, May 2018 Copyright Wiley-VCH Verlag GmbH & Co. KGaA. Reproduction with permission. Courtesy of INEOS in Cologne.

If a planned collection of data is not possible, this must be evaluated by the organisation by alternative methods (ISO 50006, 4.2.6.1)

§
Annex 2
No. 1, 2

A list of all measuring instruments ("list of measuring instruments") helps to keep track of whether measuring instruments subject to mandatory testing have expired, whether measuring instruments indicate faulty measurements and whether the accuracy is sufficient for a meaningful objective.

measuring site	Consumer group	gauge number	measuring principle	principle of reading	last calibration	
E-Station	shop	1234567	Counter/ Electromag-net	Autom. data acquisition IT	none, in use since 2016	1,5 %
boiler house	fuel oil	Unitop 3000	Bearing/ Length m.	on a monthly basis	April 2018	0,5 %

Table 5: Example of a list of measuring systems

Data acquisition for the plant- or energy using related area often requires a great deal of effort (measuring systems of sufficient quality are not installed everywhere nor can existing systems be read out automatically). As a first step, partial measurements of systems can be carried out e.g. with the aid of current clamps or temporary dial gauges, whilst energy consumption, power, operating times, etc. can be extrapolated.

TIP**:** When making new or replacement investments in systems, care should be taken to ensure adequate installation of measuring systems.

Additionally it is recommended, (e.g. for engines) to collect the performance data or the waste heat leaving the systems in order to gain information on optimization potential. If available, information on the load profiles of machinery should also be collected, if measurement options already exist. If these do not yet exist, it makes sense to purchase them as the next step. In this case, measurement using mobile measuring devices capable of recording load profiles is also possible.

Note: Energy data collection plan

Soon after beginning the compilation or recording of measurement data, deficits become apparent, since the existing measurement points and their recording were not previously designed for the purposes of an EnMS:

- Measuring devices are missing to detect consumers of e.g. cooling water, compressed air, gas or compressed gases; they were not required in the previous operating context.
- The measuring devices are too old and inaccurate for the EnMS, such as old measuring orifices for steam or heat quantities or electric meters up to >50 years old.
- The available values often do insufficient justice to the measuring task. They do not allow time-dependent recording, which is indispensable for recording for load profiles or consumption peaks. New electronic meters, can not only collect continuous data, but also active and reactive power can be measured.
- Especially in larger companies, so much data and accompanying information accumulates that it cannot be evaluated without the support of suitable software - so the information contained in the figures cannot even be recognized for improvements.

The amount of data increases the understanding of measurement obligations and evaluation requirements. Therefore, all measurements should be systematically planned, performed and evaluated.

Tip for SMEs:

When evaluating meters or installing new measuring equipment, the possibility of evaluating so-called "virtual meters" should be taken into account. Often further consumers or consumption ranges can be delimited from higher-level measuring points in connection (deduction/addition) with lower-level individual measurements, thus saving meters. Also the individual operation of aggregates in total counted areas allows exact consumption data or the recording of load profiles.

a) Energy performance indicators and energy baseline

6.4
6.5

Companies must prove their energy improvements and the increase in energy efficiency: The continuous optimization of the EP in comparison to the energy basis (EnB) is to be proven by measurable results. Accordingly, the energy performance indicators (EnPIs) should be processed and standardized in a comprehensible and meaningful way. The aim is to show a verifiable positive change compared to the starting point with the aid of the key figure.

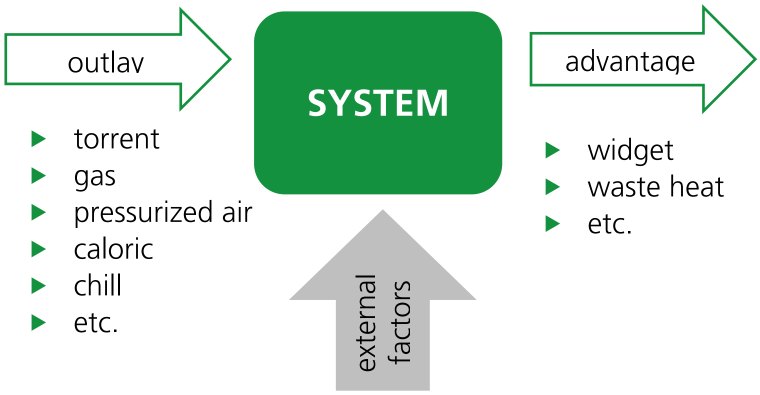


Figure 11: Simplification of the system (Ökotec GmbH)

First, the system/ investment/ process (SEU) to be evaluated should be sensibly balanced. The system boundaries should be as far as possible as narrow as necessary. Subsequently, on the basis of the material and energy flows, the system should be analysed (cost-benefit analysis) whether it is also subject to external influences. Afterwards, the quantifiable values from which the benefits can be demonstrated should be evaluated. As part of the key figure formation process, you should decide which valuation type is to be applied to the various expenses. One or more energy performance indicators can be used (3.4.4) can be established. Individual values, their relationships to each other (or models and technical simulations) can be used as a key figure. These are used to control and evaluate the EP: goals are set with the aid of the key figures, progress is tracked and evaluated. It is essential that the key figures meet the needs of those who use them (ISO 50006, 4.3.2, Table C2): A controller and an EnO may have different perspectives and correspondingly different intentions when monitoring the same system. Consequently, different key figures should also be established for the controller and the EnO.

Which key figures make sense? It is up to the companies themselves to define their own key figures. A key figure will always be a simplification of reality, but it should always be tried to simulate it as closely as possible to real conditions.

Basically, a distinction is made between the higher-level, organisation-related so-called top-down key figures and the process-, measure- or plant-related so-called bottom-up key figures (ISO 50047).

- The organisation-related key figures provide an overall overview of changes in an organisation's energy consumption within defined limits:
    - Total energy consumption of a site in absolute terms and in relation to the value added or the quantity of products/ services produced
    - These are particularly useful for commercial purposes
- The subordinate key figures provide an overview of the EP development of individual plants or processes:
    - Each process can be regarded as a closed system with costs and benefits (see Fig. 7). All influencing factors relevant to the system should be measured and recorded right from the start.
    - Such indicators make it possible (and easier) to benchmark the plants and verify the success of individual measures.

In order to compare energy consumption with a base year, an energy **baseline** (3.4.7) must be established in accordance with standards. An energy starting point is also established for each key figure on the basis of an appropriate starting period (typically 12 months to compensate for seasonal fluctuations). It can be defined as a simple ratio of benefit to effort in an initial period. However, if several factors have a significant influence on energy consumption, more complex models are necessary to take these influences into account (ISO 50006, 4.3.3 Table 2).

b) Correlation and standardisation of output basis

The collected series of consumption data of a significant energy consumer and the analysed influencing factors are compared, for example, in an Excel application to determine a possible correlation. Corresponding reference values are displayed as points in a coordinate system. If it is possible to draw a straight line as the "mean trend" of all reference values (points), a correlation exists. Such relationships can also be determined and checked by means of an analysis of the adjusted **coefficient of determination**[3]. The degree of correlation is automatically calculated by static analysis programmes. A clear correlation has a degree of determination above 90%. If the "cloud" from the reference values is too diffuse and no grade line is possible as a mean trend - there is no correlation and the influencing factor is not decisive for EP.

If a statistical correlation is given, a **standardisation (3.4.10) or adjustment of the EP from the influence of the relevant variables** can be carried out by means of a regression analysis. A linear regression line and equation is often used for this. A correlation test should be recorded in a comprehensible manner (ISO 50006, 4.4.3).

The resulting straight line equation can now be used for an exact prediction of energy consumption at a certain point in time using current influencing factors. It can therefore be calculated how the process should run in the system under the given framework conditions ("target"). Using this model, a comparison of the key figure with its respective starting point can now be traced (whilst excluding external influences) and so the change in the EP can be calculated (ISO 50006, Appendix D).

Figure 12 shows an example of **regression analysis** (left) and the course of a **standardised energy starting point** for the heat demand of a building (right). Changes in heat demand depending on temperature are shown as green dots - these are reference values. In this example, the outside temperature has a major influence on energy consumption: As the outside temperature drops, consumption increases - the reference values reflect the relationship and a straight line forms the mean value.

This allows an adjusted monthly comparison of the heat consumption for a 12-month reference cycle. A heat requirement below the target value represents a saving. This can then be assigned to a specific task (right).

---

[3] The measure of determination, also called coefficient of determination (of lat. determinatio "delimitation, determination" and coefficere "to participate"), is a measure of statistical quality.

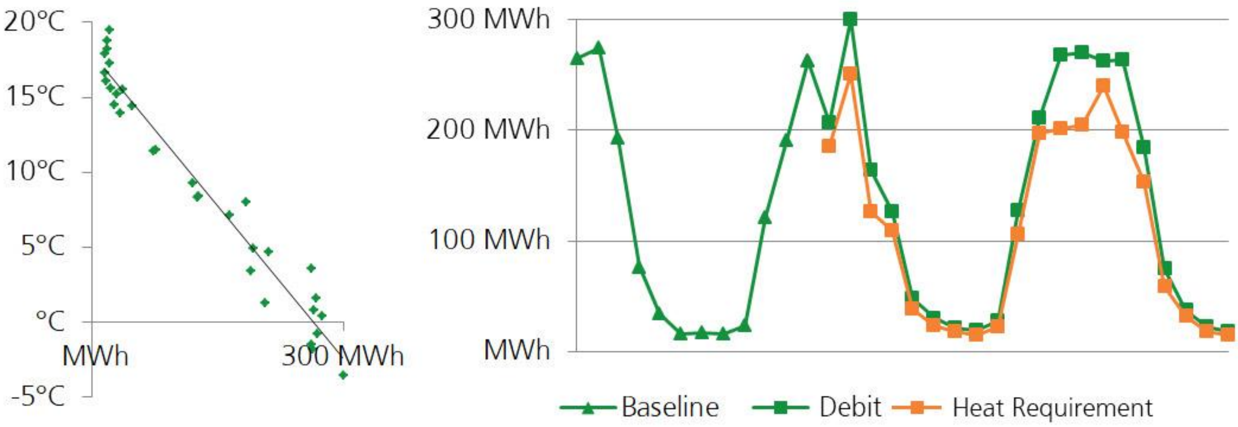


Figure 12: Determination of a normalized energetic starting point (Schneider electric)

Other examples of standardised key figures are:

- Energy consumption of an organisation in relation to added value
- Energy consumption per manufactured part (incandescent lamp, can etc.) and year
- Energy consumption per tonne of molten iron or saleable iron
  (Energy goal can be environmental and quality goal!)
- Heating requirement per m² per year standardised with the help of the heating degree days

If the static factors change (new systems are purchased, buildings constructed, technologies essentially changed, etc.), the comparison between "old" and "new" is not meaningful without an adjustment. This means that a new starting point must be created here.

Annual energy plans should be drawn up using energy starting bases and suitable key figures including the targets, similar to annual financial planning. Assuming values for the influencing factors and their use in the energy starting point equation, a prediction for future energy consumption can be made. This helps to purchase energy in a demand- and cost-optimised manner, as better conditions often result in advance rather than on spot markets.

Regular comparisons of current figures with planned data use "outliers" to point out malfunctions or unnecessary consumption in good time. Energy performance indicators are also used for internal and external benchmarking. At the same time, they make it possible to estimate the impact of energy cost fluctuations on the organisation or the product.

A **documented list** of selected **energy performance indicators** with a description of the methodology and sources of origin is one of the main elements of an EnMS and should be regularly checked for suitability and timeliness for the future. Recording and methodology for standardisation and adjustment must also be documented.

TIP: ISO 50006 and ISO 50047 provide comprehensive assistance in determining the initial bases and regression analyses with examples and explanations.

f) Energy report

It is advisable to summarize the data, information and initial evaluations with the results in points 2 and 3 (energy report). This provides a comprehensive information basis (EnMS energy starting point) for an initial management review in accordance with ISO 50001.

The task of an energy report is to provide a format that enables a quick overview of data and facts relating to energy consumption and comparisons with future energy analyses. The energy report is thus the information medium for all those responsible in the EnMS. It can be passed on to interested parties and also serves as a basis for the internal audit (see step 16) and for analyses of external experts (e.g. energy audits according to EN 16247/ISO 50002). This summary must be updated annually.

A first energy report should contain, based on the analysis of data, ideas for an initial energy saving programme with targets and measures. If the "EnMS project" is further developed after implementation of Stage I and introduced with Stage II management structures, a planning section must be added to the energy report (see step 14).

4.2 Capture of the organisational and communication structure

5.3
7.4

In almost all organisations there are regulations and responsibilities for energy management, even if this is only limited to an obligation of regularly comparing the energy bills with the own meter readings. Those responsible for energy consumption are often appointed for this reason.

§
§5, paragraph 1, page 3

All existing organisational regulations and procedures must be recorded in order to make them usable for subsequent energy management. Existing processes are usually well established and effective. They are living processes and should therefore be the basis for new regulations.

The organisational analysis usually shows that existing energy activities run uncoordinated, without overall planning and outside the strategic goals. Often deficits in communication become clear. Systematic organisational and communication considerations therefore also help to define goals and measures for an improved organisation. Their result should be part of the energy report in order to provide top management with a comprehensive information base.

Tip for SMEs:

Clarify:

- Who determines what is energy consumption (as a practice or required by procedures r)? Pay particular attention to notes in workshops, shift handover reports or accounting, which often contains figures relating to energy data.
- Who receives the energy consumption figures, data and facts for testing and evaluation? If no one is clearly responsible, there is an urgent need for action - beyond an EnMS!

4.3 Determining legal obligations and other requirements (compliance)

9.1.2

Part of good leadership and every management system (QM, EM, occupational safety, energy, etc.) is ensuring compliance with laws and other relevant requirements that an organisation has entered into. It is therefore an essential task in collecting the basic data to check the organisational practices relating to **compliance with applicable legislation, consumption and efficiency of energy and other relevant requirements of interested parties**.

Determining legal obligations requires the collection of all relevant laws, municipal regulations, voluntary commitments, energy-related approval requirements, technical regulations for the plants, processes and other relevant requirements, regulations and restrictions **(legal register)**. The register is to be **drawn up** as part of the basic survey and then **checked** for relevance at regular intervals and **updated** if necessary. However, it should only contain those regulations that apply or could apply to the organisation; otherwise the overview will be lost.

No.	Area	Level	Law/ Regulation	Short name (Link)	applicable requirement	affected process/ plant	Responsible for implementation	checked on: by :
1	Energy	State	Regulation on energy-saving thermal insulation and energy-saving system technology for buildings	EnEV	§ 4 Requirements for non-residential buildings	manufacturing hall	Employees XY	Date; Employees

last update on DD.MM.YJJJJ by Ms Muster

Table 6: Example of a legal register

Tip for SMEs:

- The energy agencies of the countries, possibly also the professional association or specialist lawyers, who deal with this rapidly growing field of law, can help with the creation of a legal register. Other energy management operators also offer support if necessary.
- Legal regulations, already sorted by topic and always up to date, can be obtained inexpensively by subscribing to corresponding Internet providers
- (cf. in Germany: http://www.umwelt-online.de/).

The legal provisions recorded in this legal register shall be compared with the procedures of the organisation and their compliance shall be assessed and documented. If uncertainties arise, experts should be consulted if necessary (see Tip). Compliance with all legal regulations should be one of the basic objectives of every organisation, regardless of whether or not an EnMS is set up. If one or more of the regulations have not yet been or are only partially implemented, this means extending the catalogue of measures from the basic survey to include the elimination of these deviations. The results of the baseline survey should also be included in the first energy report in order to complete the information base.

Note: Compliance = Compliance with legal regulations

Even without developing this first survey into a management system with a continuous improvement cycle, one result of the initial registration should be to define the responsibility for the continuous maintenance of this register and the continuous alignment within the organisation (compliance check). The legal requirements and obligations established exist in principle, even without the establishment of a formal management system, and are often punishable by law if not adhered to.

Step 5: Energy targets, action plans and savings programme, Verification of success

6.2

§ Annex 2 No. 3

Potential for improvement becomes apparent as early on as during the survey of the current basic energy status (figures, organisation, legal environment). These improvements should be noted and a **list of possible energy savings and improvements should** be compiled. All potential is recorded, regardless of whether it currently appears feasible or not. Each item on this list should be as specific as possible: Savings target, possible measures, costs incurred, time required, possible project managers. From the potential improvements listed, first **energy saving targets** can be defined and summarized in an **energy saving programme**.

For this reason the ideas that have emerged during the initial data collection must be prioritised. The priority can be derived, for example, from whether legal issues are affected (highest priority), fast, inexpensive implementation is possible, the savings volume is particularly high, etc. To set priorities, an **assessment of the main factors influencing energy consumption** must be carried out. If the baseline survey is later expanded into an EnMS, it must be updated annually.

After a comprehensive evaluation, an energy saving programme can be developed on a solid basis. It summarises all savings targets and outlines the action plans with which will be implemented.

c) Energy target

The setting of specific, measurable, ambitious, realistic and scheduled targets (S.M.A.R.T.) is one of the key tools of any management system. They are in line with the energy policy and provide the framework for further action. A distinction is made between general or strategic objectives of the organisation and operational objectives.

"Reducing energy consumption for heat generation" or *"modernising lighting"* are **strategic goals** and are part of energy policy or an overarching **energy strategy**.

Operational targets (energy targets, 3.4.15) are the targets set for individual areas, levels and functions. These are derived from the strategic goals, broken down for the respective areas. Operational goals must be measurable - otherwise they are not goals! "Objectives" that cannot be measured, i.e. whose pursuit cannot be controlled and whose implementation cannot be proven, are irrelevant to the system.

d) Drawing up action plans and verifying success

6.2.2
6.2.3

The individual saving projects for the improvement of the EP are worked out from the results of the energy evaluation and linked to the respective goals in the action plans (minimum contents in ISO 50015 5.3).

Note: Define S.M.A.R.T. goals!

- **S**pecific
- **M**easurable
- **A**chievable
- **R**ealistic
- **T**erminable

In addition to the overall overview (energy saving programme), the action plans should also include a performance review and, if necessary, the calculation of the profitability of the savings project (e.g. from project cost accounting). Each action plan should therefore document how the results are evaluated, including procedures for verifying improvements in energy performance. An agenda for an action plan can be found in Annex II.

Tip for SMEs:

Potential for improvement can be identified if the following questions are continually asked during data collection:

- How has energy consumption changed in recent years; are there trends and how can they be explained?
- Which are the biggest energy consumers and did I expect that?
- Where is there potential that can be captured by further/more detailed measurements (load profiles)?
- Which variables could influence my energy consumption?
- What tariff structure do I have and is it appropriate for production?
- Are there alternatives for energy sources (gas instead of oil or heat from electricity)?
- Are there any regenerative or CO_2-neutral energy alternatives?

The monitoring and verification of savings projects with respective measures to improve the EP should also be planned and recorded in a **verification plan** (see step 14). As a result, the existing documentation described in the measurement procedure should now be expanded upon. The general energy data acquisition plan is supplemented by measurement specifications for individual projects, as shown in Figure 13. It is important that each individual M&V plan follows the same structure as defined in the data collection plan.

9.1.1

TIP: For assistance in drawing up a measurement and verification plan (M&V) for each measure, see ISO 50015, 5.13 (see Annex IV).

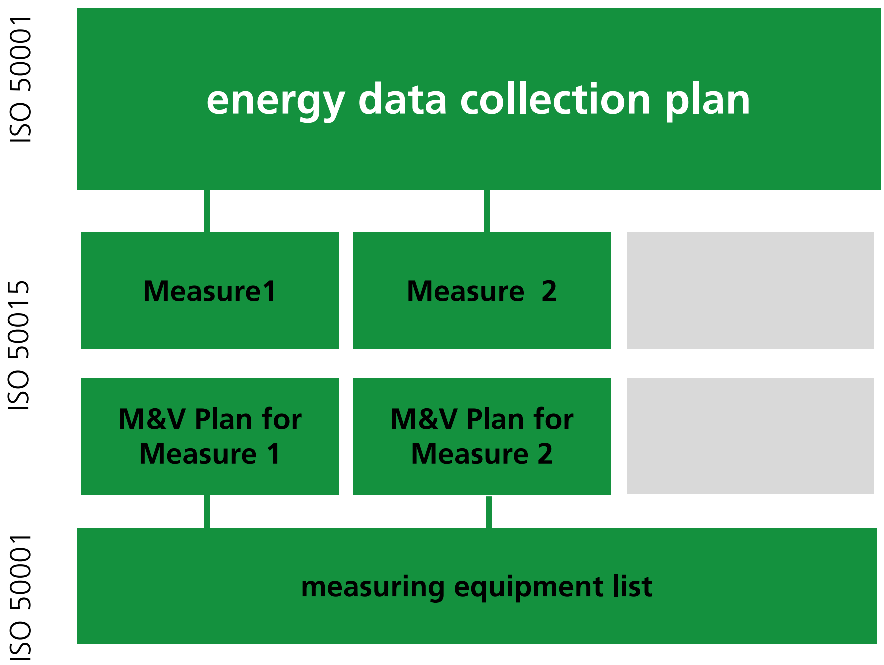


Figure 13: Plans and recording the EnMS

When beginning a process of systematic energy management, high energy savings can often be achieved with simple measures and little effort. In some cases, however, savings can only be achieved with considerable investment, which means high capital commitment with corresponding loss of liquidity. Before binding targets are decided in the review, it is therefore important not only to record the absolute investments, but also to calculate the payback periods dynamically for larger sums and longer amortisation. This makes it easier for management to make a decision, taking into account the current financial situation of the organisation.

Investment / measure	Investment costs[€]	internal interest rate[%]	technical use[a]	Saving [€/a]	Static amortisation[a]	Annuity factor[1/a]	dynamic amortization[a]
Project 1	120.000	12,0	10,0	40.000	3,0	0,1769	3,94

Table 7: Example of a dynamic amortization calculation

Tip for SMEs:
A simple sensitivity calculation can be carried out by calculating the dynamic amortization several times with different energy cost savings (due to price changes) and with different interest rates. This facilitates the choice of the appropriate time for the implementation of a meaningful but currently uneconomic goal.

Many companies calculate the use of new machinery and equipment on the basis of internal interest rates. This often leads to positive results even with longer payback periods, since a capital investment in new production techniques can be more sensible than other financial investments. This also applies in principle to investments in increased energy efficiency, which is why this calculation method is also suitable for such investments. However, their application depends heavily on a company's liquidity. (This is also the basis for many contracting models.)

Tip:
Especially at the beginning of energy management, large saving potentials quickly result from simple and cost-effective measures:

- ✓ In many cases, organisational changes can reduce idle times of systems
- ✓ Employees can be encouraged to shut down systems or prevent unnecessary consumption during breaks (regular training)
- ✓ Maintenance and cleaning of systems and filters to reduce pressure losses
- ✓ Cleaning of equipment or clothing with aids other than compressed air
- ✓ Use of waste heat to increase room temperatures or for cooling by means of absorption chillers

The recording of load profiles and the subsequent comparison with production processes often reveal potential. The energy supplier often provides load profiles free of charge.

Energy costs are also developing dynamically (prices are increasing). For this purpose, sensitivity considerations are recommended, which are used to determine from which energy price an investment makes sense. Planning of energy use must also be taken into account. Larger savings can have an impact on tariffs, which may promise further benefits (connected loads), but can also lead to cost increases (acceptance thresholds).

e) Energy-saving programme

The energy saving programme (which is a summarised overview of the projects) and the corresponding action plans (consisting of detailed verification including verification methodology and M&V design) are decided on by the Top management in a (first) review after the final evaluation.

The pursuit of the goals must already be regularly controlled at the first level and the processing status must be documented. Monitoring according to a defined process (internal audit) is only necessary after entering a continuous improvement cycle (cf. description of steps 14, levels II and 17 in level III).

companionship	savings target	planned efficiency measure(s)	Planned investment	CO_2 savings	Economic viability assessment	Responsible - responsible	Project status	Link Verification (Details)
Efficiency GmbH	Power savings of 37,400 MWh	Control optimization and replacement of old transformers	3.150 €	16,800 t/a	< 2	Technical planning	Processing completed	Action plan 1
Efficiency Logistics GmbH	Reduction in electricity consumption by 74 MWh	Only allow pumps to run automatically	0 €	48 t/a	instant 6.500 €/a	Technical planning	Effectiveness tested	Action plan 2
Energy Efficiency limited liability company	Reduction of electricity consumption by 1,350 kWh/luminaire	Replacement of efficient light bulbs	100 €/ light	878 kg/ luminaire t/a	<3	housing technology	Machinery runs to full capacity	Action plan 3
Efficiency Logistics GmbH	Reduction of electricity consumption by 50 MWh	Lowering the compressed air (compressed air) by 1 bar	0 €	31 t/a	instant 6.150 €/a	Technical planning	Effectiveness tested	Action plan 4
Efficiency Logistics GmbH	Reduction of electricity consumption by 1,000 MWh	Reduction of compressed air network losses due to non-closing steam traps	10.000 €	570 t/a	< 0.2 55.000 €/a	Production Manager	Effectiveness tested	Action plan 5
Efficiency Foundry GmbH	250 MWh reduction in electricity consumption	Installation of an energy control system for efficient operation of furnaces	15.000 €	169 t/a	< 1 23.550 €/a	Production Manager	Processing completed	Action Plan 6

- Planning recorded/entered
- Processing started
- Machinery runs to full capacity
- Processing completed
- Effectiveness tested

Table 8: Example of energy saving measures from energy programmes for industry

companionship	savings target	planned efficiency measure(s)	planned investment	CO_2 savings	Economic viability assessment	Responsible - responsible	Project status	Link Verification (Details)
Efficiency GmbH	Power savings of 37,400 MWh	Control optimization and replacement of old transformers	3.150 €	16,800 t/a	< 2	Technical planning		Action plan 1
Energy Efficiency limited liability company	Reduction in electricity consumption by 74 MWh	Only allow pumps to run automatically	0 €	48 t/a	instant 6.500 €/ a	Technical planning		Action plan 2
Savings Ltd	Reduction in power consumption by 1,350 kWh/ luminaire	Replacement of efficient light bulbs	100 €/ light	878 kg/ luminaire t/a	<3	housing technology		Action plan 3
Transparency GmbH	Reduction in electricity consumption by 50 MWh	Lowering the compressed air (compressed air) by 1 bar	0 €	31 t/a	instant 6.150 €/ a	Technical planning		Action plan 4
Efficiency Logistics GmbH	Reduction of the energy consumption of trucks by 5%.	Installation of CMS devices	18.500	33 t/a	1,5	Technical planning		Action plan 5

Planning recorded/entered
Processing started
Machinery runs to full capacity
Processing completed
Effectiveness tested

Table 8.1: Example of energy saving measures from energy programmes for service providers

Tip for leaseholders:

As far as the leasing agreement allows leaseholders 1should enter into a dialogue with the building management system operator in order to determine possible potential energy savings: Who and on what basis are the guidelines established for the existing settings? Are they comprehensible and needs-oriented or is there an action required? For example, have the temperature values for the server room air-conditioning been set too high? Is the height of the air circulation rates of the buildings appropriate? Etc.

In the case of the buildings' own operation, the optimum adjustment of the heating, ventilation and air conditioning system and the heat losses through the building envelope (physical building properties) also plays a role. The"human factor" must not be neglected. The influence of manual control can sometimes have a significant impact on energy consumption.

Step 6: First management evaluation

With the data from the first steps, top management and, if possible, all bodies and persons with a significant influence on energy consumption should carry out a (first) **management review.** During this review basic data collected is presented, explained and discussed. Afterwards, it's time, to

- prepare a list of possible energy savings
- develop a first evaluation of the essential energy consumption influencing factors and/or the essential energy consumers
- create an energy saving programme and
- draw up energy action plans to follow up the established measures.

Subsequently, some decisions have to be taken by the Top management including:

- determining the context and prioritising internal and external issues relevant to energy planning
- identifying risks and opportunities related to the EnMS
- formulating an initial energy strategy (energy guidelines, etc.) for the organisation
- confirming compliance, compliance with all energy-related legal regulations or the formulating measures to ensure compliance in the future
- determining / confirming the energy consumption, the main energy consumers and influencing factors, energy costs. These form the basis of the energy targets.
- confirming or deriving the energy targets and energy action plans for the next period
- deciding on the next steps (placing the system on a more formally stable footing and moving on to level II or simply updating the basics annually and remaining at level I for the time being)
- determining a suitable organisational structure to process the objectives, record data, regularly communicate and, if necessary, further develop the EnMS in the next stage (energy officer, energy team, etc.)

§
Annex 2
No. 4

At the latest the results of this first review should be communicated in an appropriate form for information, greater involvement and motivation of all employees. This comprehensive information has the potential to involve all employees in cost-cutting efforts.

Stage II – Integration of the EnMS into the company processes

The first steps have laid the foundations on which an EnMS is built. The self-analysis carried out already makes it possible to identify and implement substantial savings. For some companies this is already enough. You can easily continue the annual data collection and management evaluation with updated objectives.

However, many will continue to the next stage due to the savings successes, in which a standard-compliant and ultimately certifiable management system according to ISO 50001 will be established in order to save even more energy and money in a further 12 steps.

In steps 7 to 14, essential management system structures are set up and the necessary tools and aids are made available.

The heading of this stage makes it clear that no artificial organisation should be set up for the EnMS. It is better to supplement the existing organisation and only introduce new processes where necessary. The following steps therefore describe the most important elements that ensure the effectiveness of the EnMS in all areas of an organisation.

Step 7: Energy policies

An energy strategy has already been formulated at the start of the project or in the first review. At the beginning of the development of fixed EnMS structures, a comprehensive **energy policy** (3.2.4) should now be established as the Top management's primary objective on the basis of initial data collection. As in other management systems, this defines the working framework and the strategic goals of the EnMS. The EnMS (3.2.2) is defined as a set of coherent and interacting elements designed to achieve the principles in the energy policy and the energy objectives (3.4.13) in the existing business context. 5.2

Top management determines the importance of energy management. It is therefore important that the energy policy is not only "approved" and **signed** by top management, but that Top management is directly involved in its formulation. This ensures that the strategic focus of the EnMS takes into account internal expectations and the requirements of external interested parties. Furthermore, the policy gives the impetus to all areas of the organisation to provide and receive the necessary support: It is therefore important to regard policy as one of the most important communication instruments, both externally and, in particular, internally. The policy should not only meet the standard requirements, but should be written in such a way that employees can recognize their own company. This makes it look credible.

If there is already a corporate policy and, if necessary, other management systems that require such a policy, the existing policy should be expanded to include energy-relevant priorities after the expectations of Top management have been formulated. The obligations to comply with the law and the principle of continuous improvement are also the basis for other management systems. Minimum components of an EnMS policy are specified in the standard which includes:

- Appropriateness of the purpose and context of the organisation
- Compliance with applicable laws and obligations is a requirement without which no management system can exist permanently.
- In the case of EnMS, there must be a commitment to continuous measurable improvement of EP
- The same applies to the principle of continuous improvement (PDCA cycle), which is the basis of all management systems and describes the process by which an organisation "learns".
- As shown in the previous steps, the determination of the energy starting point on which the strategy and goals are to be built is also a basic prerequisite for an EnMS.

- Top management must provide the necessary resources for this and should emphasize this in the energy policy
- The procurement of energy-efficient raw materials, plants, products and services is an essential factor for the functioning of the EnMS.
- When designing systems, processes and buildings, the focus should be on energy efficiency
- If an organisation has peculiarities in energy consumption that are to be dealt with as a focal point, it makes sense to emphasise these in the policy as essential strategic goals

Energy policy must be reviewed, confirmed or updated annually. (ISO 50001, 9.3.4) Whoever uses an EnMS should ensure that it is passed on to all parties involved. This also applies, for example, to subcontractors (or service providers), so that their employees also adhere to general rules of efficiency. The energy policy can (but does not have to) be made known to the public (e.g. via the website).

Tip:

A session based on the metaplan principle is suitable for drawing up an energy policy:

Various aspects (continuous improvement, compliance, savings through environmental protection, etc.), the opinions, ideas and wishes of those involved are collected, summarised and sorted according to importance. The drafting of a policy can be done later in a small group or by the representative. It is then approved by the management.

Step 8: Organisational structure

If the organisational analysis revealed deficits in the fourth step, it is now the latest time to create a systematic and organisational framework for the EnMS. A responsible manager **(Energy manager, EnM)** must be appointed by the Top management, who bears overall responsibility for introducing, maintaining and improving the EnMS. 5.3

The EnMS is anchored in the organisation by appointing an energy team. To manage the administrative tasks in daily business, the Energy manager can designate an EnO to take over the daily work, even if there is no longer a direct requirement (see step 2).

The head of the energy team (EnO, if applicable) must have the authority to introduce, maintain and control a functioning EnMS. In particular, they must have the authority to approach top managers who support him in his work. He should have or acquire experience and qualifications in energy-related areas. Even if there are no explicit requirements for documentation and communication of the organisation's structure in the revised standard, it is recommended to document the roles, tasks and areas of responsibility for each of the energy team members, to include them in the organisational structure/organisation chart and to communicate their roles to the employees.

It is important to **organise internal communication** from the outset, i.e. the fast and efficient exchange of information relating to the energy status, new findings and ideas. It is especially helpful to regularly (e.g. quarterly) establish such an exchange between top management and the energy team in larger organisations. The energy team should monitor the current energy status, the implementation of the energy goals and define further if necessary supplementary measures. It supports Top management and the EnO in all tasks related to the introduction and maintenance of an EnMS and ensures its implementation and communication in all areas of the organisation. The members of the energy team should therefore come from all energy related areas and departments. Thus, the entire knowledge relating to energy-relevant processes is represented in the EnMS team. An effective energy team is a very helpful tool for successfully and quickly implementing an EnMS and continuously saving energy. All employees should be motivated to make suggestions and comments regarding the EnMS. (ISO 50001, 7.4)

The following example illustrates the possible structure of an energy management organisation structure:

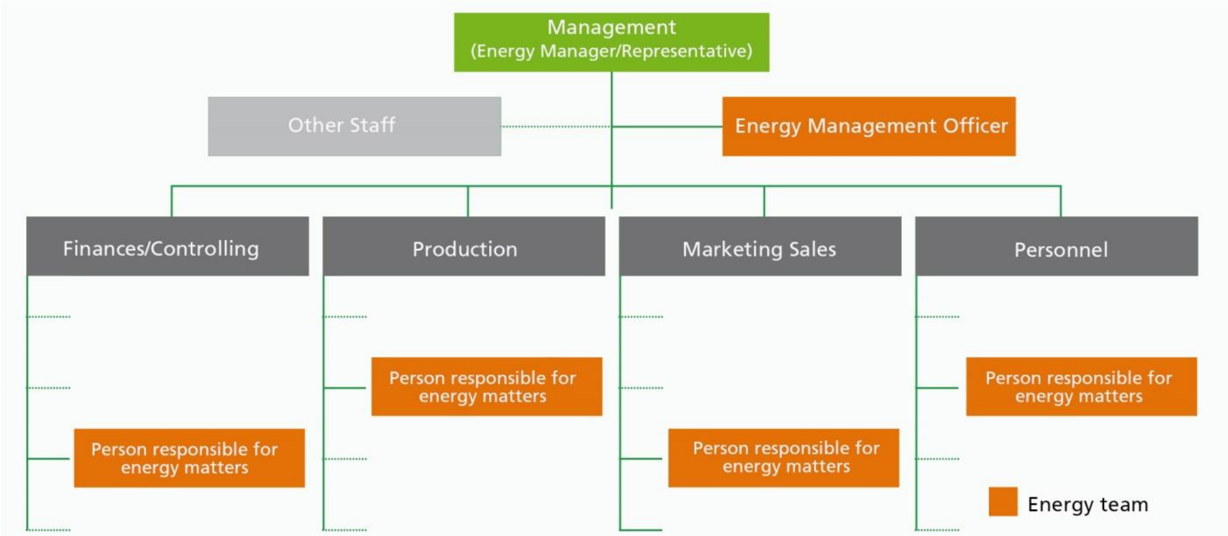


Figure 14: Example of an energy management organisation structure

Various types of presentations have proven invaluable for the tasks and authorities of the responsible personnel in management systems. If systematic management is already being pursued, the responsibilities within the framework of an EnMS should be integrated within it or the same type of presentation should be used.

Available roles:
R - responsible
A - assistance
I - information

	Energy officer	Energy team	Top management	Sales management	Production management
Data collection and monitoring	R	A I		A	A
Energy report	R	A I	I		
Energy management programme	A	I	R		
Evaluation	A	R	R		
Training and awareness	R A	A I	I	R	R
Purchase of energy efficient components	A	A I	I	R	
Technical improvement measures	A	A I	I	R	R
Energy input in production	A	A I	I		R

Table 9: Example Responsibility matrix

The necessary resources must be made available to implement the energy policy and the energy saving programme. Only in this way can these be achieved within the desired quality and required timeframe.. Therefore, resources should already be indicated in the energy programme. In addition to the required working time, the Energy manager or representative will also need equipment, professional competence, access to supporting functions in the organisation and potentially the possibility of obtaining external support within the scope of the budget.

Tip for SMEs: necessary resources

- **Time**: If an energy team is appointed, the members must have access to a time fund (which is highlighted for example, by the participation of top management).
- **Money**: The funds made available to the target managers should be budgeted. In addition, the commissioner should have a fixed budget at his or her free disposal. The possibility of increasing this by means of immediate savings has a motivating effect!
- **Support functions**: Support from important functional areas (IT, maintenance, R&D, finance) should be specified in the task and function description. If an energy team is set up, these functions must be specifically integrated.
- **Personnel**: The information and training of employees is an essential factor for their active participation. It can lead to considerable savings. The human resources department, as a support function, needs resources for this.
- **Equipment/Technology**: Not only measuring instruments and equipment for data acquisition are required, but also the competence to operate, install or maintain them.
- **External consulting**: The representative or the responsible department should receive a budget for consulting or service.

Step 9: Documented information

A documented system is indispensable to management system. There is a good reason for this: only what is written down (documented) can be improved. If there are only verbal agreements, experience shows that different people act in the belief that everything is the same but in fact the practices are often very different. 7.5

Only one document specifies a "target" with which an "actual" result can be compared. Therefore, documentation within the management system framework is not a "nonsensical duty", but requires continuous improvement. However, the documented system should be appropriate to the purpose of the system and the size of the organisation. The **Documented Information** (3.3.5) describes the main elements of an EnMS: processes, procedures, energy relevant principles and criteria for procurement and the proof that the EnMS is effective. At least the following elements should be **documented and stored** in the EnMS:

- Scope (methodology including the determination of risks and opportunities from the business context and the result of the R&C evaluation)
- policies
- Energy plans (sequence and role of individual actors)
- Energy evaluation (methodology, criteria, result)
- Energy performance indicators (methodology and results)
- Starting point (methodology and result)
- goals
- Action plans / data collection plan, measurement and verification plans
- Methodology and results for ensuring competence
- Documentation regulations (methodology and results) and documented information from external sources that are relevant for the planning and operation of the EnMS
- technical processes and procedures, including design activities
- Methodology and results for performance evaluation Methodology and results for conformity
- Internal audit programme and proof of its implementation
- Methodology and results for Management evaluation
- Methodology and results for dealing with non-conformities

Examplary is the description of energy data acquisition and processing (cf. Hints: "Energy data acquisition plan"). In order to ensure the quality, reproducibility and comparability of data, there must be a definition of how, how often, when, in which time frame and quality etc. these are collected. This information may also form part of the introduction to the energy report.

"Documented information" in the sense of a management system standard is a meaningful collection of necessary specifications and evidence - not a hundred pages that no one will read later. The management's own documented system should be built up and lived in such a way that all concerned personnel know what, how, when to do actions required by the EnMS and how they personally contribute to its success.

Furthermore, all information carriers and methods should be meaningful. The documented information can consist of a graphical or text-graphical representation of the processes. Modern data processing workflow programmes offer a good alternative to purely textual descriptions. But also in the "office world" sub graphics and descriptions with links to verification documents, forms etc. can be generated. Programmes such as Microsoft Visio or PowerPoint, which also enable links to other documents, are suitable for visual display. An IT solution should enable all employees to access the regulations.

Note: Documented information

- Documents reflect specifications in EnMS, such as procedures or methods
- Protocols and other records of the results serve as evidence of performed activities

Step 9 should be implemented in parallel with the other steps. At the beginning, however, a definition of the type and manner of documentation (text, workflow, combination, IT basis, paper basis, etc.) and agreements on the so-called **"control of documents"** are required. 7.5.2 7.5.3

Document control describes various aspects of unique identification (e.g. numbers, revision levels, responsibilities for content) and their verification, as well as specifications for archiving older versions and records.. It is important for the **"control of records"**, that they are legible, identifiable and traceable back to the respective activity.

The scope of the documentation depends on the type and size of the organisation and the complexity of the processes. If a documentation system already exists due to an environmental or quality management system, the EnMS-relevant documents should be integrated in it, since the employees already know the existing system. The number of records in particular increases over time therefore a clear hierarchical structure should be defined at the outset. In this way, new regulations can be integrated at any time (through links) and made easier to use for those affected.

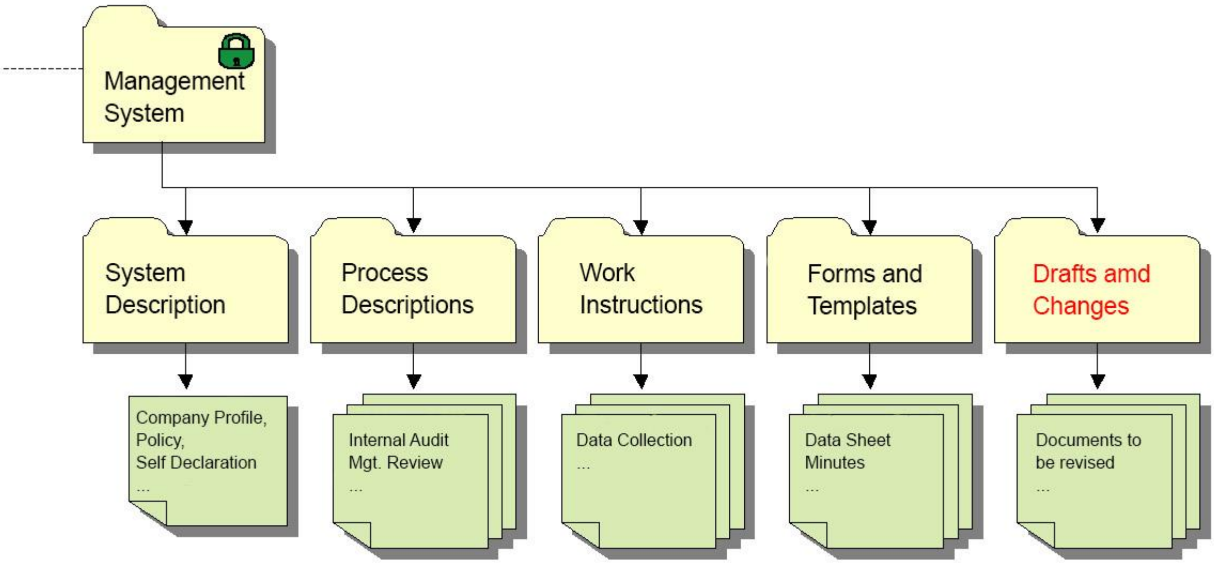


Figure 15: Example of a documented system structure

Tip for SMEs:

For an overview of all relevant EnMS documents, it is recommended that a list of all applicable EnMS documents (document name, person responsible, revision date and number) be created. Changes can be entered in this list; and always up-to-date

Step 10: Operational planning and control

In addition to determining organisational and system-relevant processes, the activities that have a significant influence on energy consumption (heating cycles, plant operation, maintenance and repair work, purchasing of energy-relevant raw materials and plants, building management, fleet operation, etc.) must be described and planned precisely. 8.1

It is best practice to establish and document in order activities that (can) have a major impact on consumption should be defined. In this way, the processes can be systematically improved in the future when new experiences are gained. **Operational planning and control** means planning and carrying out the activities associated with the main energy consumers in such a way that they result in the lowest possible energy consumption with the highest possible efficiency.

From the first analysis of energy factors, processes with a large influence on energy consumption are already known. A close examination of all processes and all energy-relevant processes in the organisation (possibly already recorded in other management systems such as QM) shows which processes should be described more precisely at least in the first approach and thus be included in the next evaluation of energy influencing factors. Experience has shown that this chapter should be supplemented by experience in operating an EnMS.

The following processes, which should be regulated and described, have a lasting influence on energy consumption:

- Description of the procedure for energy-efficient processes and plants
- Maintenance and repair of buildings and systems
- **Commissioning, continuous operation and/or shutdown of** large energy consumers (melting furnaces, air conditioning systems, compressed air)
- **Selection and purchase** of energy-efficient raw materials, economical equipment and services
- the **design** (planning) of energy-efficient processes and plants
- the **planning and construction** of structural facilities
- **Development of** energy-efficient products (services) and processes,

Firstly, the existing planning processes should be examined in detail: Is there any impetus searching for the most energy-efficient solutions possible? If not, the processes must be supplemented. In EnMS, managers have the task of systematically searching for such possibilities (technologies, procedures, processes) on the market together with the energy representative.

Design of energy-relevant processes

In particular, new facilities, facilities and buildings have a significant and long-term impact on an organisation's energy consumption. These should therefore only be planned and documented with accompanying energy efficiency considerations and optimisations. 8.2

The same can apply to the energy consumption of services and products throughout their entire life cycle, which can be much higher than the consumption during their production. Therefore, research and development activities of particularly energy-related processes should be defined (although ISO 50001 does not provide any further information).

Existing plants or their use or operation can often be optimised, especially if the employees experience is used. To this end, systematic research programmes should be introduced or existing programmes supplemented (e.g. within the framework of Total Productive Maintenance (TPM) activities). It is important that all persons who work for the organisation or on its premises communicate, comply with and, if necessary, control the energy-efficient processes relevant to their work.

Tip for SMEs:

The described processes will only have an effect if they are not "theoretically" defined, but are oriented towards the life of the organisation. To this end, known processes should be reviewed together with all those affected through the "glasses" of energy efficiency and, if necessary, adjusted. Under certain circumstances, processes are already good and only need to be documented for the first time in order to have a basis for future improvements and to ensure that they are always carried out in the same way.

Furthermore, at least the employees concerned must be informed or trained on how they should proceed in the future. In order to achieve even greater acceptance, the training should point out that ideas for improving procedures arising from their application are always welcome with the Energy Officer.

Procurement of energy-relevant facilities, materials and services

Building or system specifications should summarise information on energy consumption in a special chapter. For example, when purchasing machines, binding information on consumption, e.g. of electricity, heat, gas, cooling or compressed air, should be explicitly requested at defined operating points. These should be included within the contract and be subject to financial penalties if not complied with. 8.3

With the help of precise consumption data in quotations, life cycle cost comparisons can be made that take into account not only depreciation but also operating costs (concept of TCO = total cost of ownership). Often more expensive machines and systems with more efficient engines or buildings with better equipment are much cheaper than „cheapest buy" after just a few years due to the lower operating or maintenance costs. Already in the enquiry and procurement process, the purchasing department has to inform potential **suppliers** that the energy consumption of the requested plants or services will affect the award decision substantially. Criteria for this evaluation should be established prior to the request and communicated to suppliers.

Step 11: Raising Awareness, training and skills development

It is not possible to implement an EnMS without employee involvement. No management system functions without the commitment of employees who consistently "live" the established procedures. This is especially true for an EnMS. All employees decide several times daily whether they want to save energy, whether they want to switch off the lights or the PC, shut down systems during rest periods, switch off the compressed air when it is not in use, and much more. 7.1-7.3

Employees know their working environment well, they are above all the ones who provide information on how to save energy, use it more sensibly or, for example, reduce energy use by maintaining a lower working temperature level. It is therefore important to influence employees' **awareness** and to change their **behaviour** in the medium term. Employees cannot be „forced" to save energy. Internal rejection cannot be controlled or sanctioned, but can torpedo any management system. If employees are motivated, they will take care to keep energy consumption low and contribute to improvement.

EnMS-related training topics can come from general training need assessments, comparison with a competency matrix, or from the Energy management representatives experience who keeps abreast of developments in the organisation, industry, and the market. The information and training required by all employees is summarized in a **training plan. The** training required depends on the age and maturity of the system and the role of the personnel:

- Initial information provided about the EnMS explains Top management's intentions based on the energy policy, the first draft objectives and describes the system functions whilst referring to information and communication options and calling for participation of all employees. The focus is on the possibilities for energy-efficient behaviour of each individual.
- Topics on energy saving (also in the private sector, which increases attention value and acceptance) and new efficient techniques should be suggested to all employees repeatedly in order to maintain motivation, to show what personal advantages can be gained from this approach and thus promote further ideas on a broad basis.
- Depending on the qualifications of the employees, special training may be necessary if their work can have an influence on the energy consumption (of the plant).

The energy management officer, energy officer and, if applicable, the members of the energy team or all the specialists must be kept up to date about energy savings on an ongoing and independent basis. Topic votes can be coordinated in the meetings of the energy team.

It makes sense to provide basic training in energy-saving techniques, processes and in management systems. Basic training in auditing techniques should also be provided to the personnel carrying out internal EnMS audits. External further training relating to EnMS-relevant topics should be provided, for example training on the measurement and verification processes.

- Management should be continuously trained and informed about the current energy situation in order to participate in setting strategic and operational goals and to promote their implementation in all areas.
- Important topics (e.g. new processes, new technologies, energy-efficient design, etc.) should be repeatedly supplemented by the Energy Officer from his knowledge of the market if the specialist departments do not develop activity in this area.
- Service provider employees or persons acting on their behalf should be trained on energy aspects of the system and processes affecting them in order to promote their participation in the EnMS and their understanding of energy-relevant processes as well as to encourage them to think and act in terms of energy performance

Tip for SMEs:

Especially at the beginning it is worthwhile to carry out training courses in the form of "workshops", in which the employees are invited to participate and have the chance to re-plan defined processes and adapt the design with their knowledge.

In order to sensitize employees on a broad basis, the following are suitable, among other things:

- Energy saving suggestion campaigns (results become part of the energy saving programme)
- Information on the amount, costs and potential savings in energy consumption, if necessary in comparison to other parameters, such as wage or raw material costs
- Energy consumption barometers, energy cockpits and target achievement information on bulletin boards that provide direct feedback on the success of ongoing activities

Feedback on training quality should be sought in order to continuously improve it especially the essential influencing factors for greater energy efficiency which should be considered in the training plan. Ongoing system training courses can contain energy topics, for example quality management, safety, but especially those about environmental protection. The path from the training concept through its implementation and the subsequent feedback is planned in step 8 and documented according to the specifications in step 9.

Step 12: Type and structure of communication

Quality management focuses on customers, environmental management on neighbours and the interested public, and occupational safety management on employees. There is no specific stakeholder group for communicating information about an EnMS. The EnMS also has many links to different partners, although not as pronounced as in other MS. For a list of possible relevant parties interested in an EnMS, see step 1. 7.4

ISO 50001:2018 builds the entire planning process on the results of the risk and opportunity assessment, which in turn will be developed from the analysis of the interests and requirements of interested parties. Therefore, communication with interested parties plays an important role in the revised EnMS: this is now the key to an informative input for planning.

Communication of EnMS results as such is still not mandatory. The **definition and documentation of a procedure that** regulates both internal and external communication is a requirement of management system standards. The procedure must be introduced and implemented in such a way that all personnel working in the organisation or on its behalf (e.g. also extended workbench, external companies) are empowered to submit comments or suggestions for improvement of the EnMS and the EP (see also step 13).

Today, the publication of energy policy (beyond the operational framework) is not an obligation in ISO 50001, but an option. It is important to note that at least the energy policy should be made available to interested parties (if necessary).

After identifying all communication channels that an organisation wants or needs to adopt, these should be precisely defined (e.g. in a process description according to step 10, documented according to step 9). Contact persons and internal responsibilities must be defined for each communication channel. It shall also describe the minimum information to be exchanged or passed on and the frequency with which this should be done.

a) Internal communication

As explained above, the information and systematic involvement of all employees is the decisive factor for the success of any savings effort and the EnMS. This systematic involvement contributes significantly to the participation in the EnMS. The procedures for this are divided into the systematic training described above (step 11) and the general ongoing information.

The communication of energy policy requires that all parties involved adhere to the energy strategy and involve it in their work. In addition, well-informed and involved employees are much more motivated in implementing the goals. All known means of contact with employees are suitable: e.g. employee magazines, intranet and internet, e-mail and bulletin boards, but above all meetings and training courses. Providing information on the status of cost-cutting efforts, achieving goals and implementing target suggestions from the staff keeps their attention high. They increase their willingness to make a personal contribution, e.g. through their own ideas. This shows once again that the EnMS is not implemented without the employee support.

b) External communication

Authorities should often also be contacted, e.g. if tax credits or legal compensation and subsidies are to be claimed. Such contacts are also often helpful or necessary when using e.g. regenerative energy generation plants. In many cases, the introduction of an EnMS is partially eligible.

The main starting points for communication in the EnMS are certainly the **energy suppliers**, who now often have to maintain or maintain their own consulting capacities. From their position, they often have a great deal of knowledge about potential savings.

Due to their comprehensive knowledge, **energy consultants** are basically interesting communication partners. In addition to independent consultants and specialized engineering offices, these include the **energy agencies that have** been established in recent years.

Customers are also an important target group in communication, especially those whose production is very energy-intensive (aluminium) or which consume energy when in use (electrical appliances, cars). In this case, marketing often becomes an "essential energy factor" and thus a process that should be defined and described in more detail after step 10, because the relevant customer requirements and consumption must be included in the planning (even if ISO 50001 does not explicitly require this).

The necessary communication with **suppliers** of equipment and materials has already been described in step 10 and communication with **service providers** operating on the site or under the name of the organisation in step 11.

The **capital providers** of an organisation's investors and **banks are** also certainly interested in the energy-saving activities, especially in the associated cost reductions and upstream investments. Today, analysts evaluate the CO_2 emissions of an organisation in relation to added value which is largely determined by energy consumption, as a key indicator.

Energy policy can be made known to the **public** (e.g. on the Internet) in order to show the company's own commitment.

Step 13: Dealing with corrective and improvement measures

Dealing with non-conformities and corrective measures, as referred to in all standards, is the essential instrument to make an organisation more efficient, better and safer. Suggestions for improvement and the discovery of shortcomings and risks lead to new ideas for savings, corrections and measures to prevent waste. They are the basis of continuous improvement in MS. 10.1

Corrective and improvement measures are fed by everything that happens in an organisation. Tours of every kind, internal and external audits, suggestions from employees, ideas or measures from meetings etc. always lead to insights. What can be done better, what is wrong and can be corrected, how can **risks** be identified? It is important to immediately record the constantly incoming suggestions and possibilities for improvements, so that no good thought is „lost". If the goals can be realistically implemented, they should then be included in the improvement plan in the next step.

In addition to a general numbering, the following columns are recommended in such a plan:

- **"Cause/ problem/ improvement (and target, if applicable)".** This is often not considered important. However, it is essential and represents the cause of a deviation, a risk or may be an idea for improvement.
  If measures are implemented, they can be successful without solving the real problem. In the so-called **"effectiveness assessment"** (obligatory according to ISO 50001) the problem may still exist, without being noticed although measures have been successfully implemented.
- **The „Action"** column may contain several measures for troubleshooting or implementing an idea. Measures are defined by the person responsible for implementation or a team.
- For ALL measures (such as for targets in the energy programme), columns must be setup for **„responsible" personnel** and **„deadlines" established** so that they can be planned and tracked (see S.M.A.R.T.).
- A good system to show the **status of measures** is important. The graphic display in the example has proven its worth and can also be supplemented by „green/yellow/red" traffic lights to indicate that measures have been exceeded compared to the plan, are outside the limits or have significantly deviated from the plan.
- Without the column **"Comment"** nothing works, as everyone knows.

- Columns for department identification, type of task, etc. can also be useful. Then this plan is also suitable for other systems. Ideally, the organisation can access a plan for its entire management that can be sorted and well managed by internal identifiers.
- Furthermore, a column is necessary to **verify** the success of measures. This should plan how and when the success of each individual measure should be examined.

No./ Source	Cause/ Findings/ Improvement	Measure(s)	Responsible - responsible	Dead-line	state	remarks	Link Verifica-tion (Details)
1st Int. audit	Switching off the machines during pause times	Inspection where possible while maintaining qual-ity	technical engineering	09/20xx		Check only possi-ble step by step	Action plan 5
2nd Ext. audit	Are 2 out of 3 drives sufficient?	Check and if necessary a mo-tor in reserve	technical engineering	05/20xx		System is current-ly only operated with 2 motors	Action Plan 8
3rd Int. audit	Outdoor light switch-off at night5 h	Decoupling of exterior and interior lighting	Electrical building ser-vices	01/20xx+1		Switch cabinets in the installation	Action Plan 11
Fourth round.	Compressed air losses at the joining system	Sealing and fol-low-up at the weekend	upkeep	04/20xx		Switched off, tightness con-firmed	Action Plan 14

Planning recorded/entered — Processing started — Processing runs to full capacity
Processing completed — Effectiveness tested

Table 10 Example of an improvement plan (own presentation) for industry

No./ Source	Cause/ Findings/ Improvement	Measure(s)	Responsi-ble	Deadline	state	remarks	Link Verifica-tion (Details)
1st Int. audit	Shutdown of com-puters, printers, scanners etc. during pause times	Check where possible	energy team	09/20xx		Check only possible step by step	Action Plan 12
2nd Ext. audit	Are 2 of 3 lamps sufficient?	Check and, if necessary, take out a person	facility	05/20xx		Lamps are cur-rently only op-erated with 2 luminaires	Action plan 9
3rd Int. audit	Outdoor light switch-off at night 5 h	Decoupling out-door from indoor lighting	Electrical building services	01/20xx+x		Switch cabinets in the installa-tion	Action plan 10
Fourth round.	Light sensor for poster lighting is defective	Changing the control via build-ing technology	upkeep	04/20xx		Sensor unin-stalled, control not yet changed	Action plan 13

Planning recorded/entered — Processing started — Processing runs to full capacity
Processing completed — Effectiveness tested

Table 10.1: Example improvement plan (own presentation) for service providers

Tip for SMEs:

To effectively manage goals and improvement measures, they simply entered in a sortable Excel table. (Access databases have also proven their worth for efficient management of many measures, especially as it is easy to note down additional characteristics such as the department concerned, the first admission date, the history in the event of shifts, etc.).

This table is divided into "freestyle measures" (objectives and new ideas) and "compulsory measures" (problems, problem prevention measures). In addition to the name of the table, this makes it clear to every employee that this is not a list of "errors" but a tool for improvement. The ideas section often feeds on new goals. The better a management system runs, the greater the proportion of "free skating" measures.

Step 14: Benchmarking and evidence for the improvement of EP

Successful energy savings and the achievement of targets are often difficult to prove due to production fluctuations, model changes or organisational changes. Therefore an energy starting point must be determined at the beginning (which was already done in the 4th step) together with recording significant influencing factors on energy consumption. 9.1

With the help of meaningful and appropriate key figures (energy consumption per unit of time, etc.), is data can now be compared over different periods. In this process, changes or, ideally, improvements in EP should become apparent.

a) Benchmarking

The energy data collection in step 5 showed how the first comparative figures are often developed "intuitively" in order to compare energy data over different time periods (horizontal) or different plants, locations, industries (vertical). Regardless of whether plants of the same type, plants with the same product, similar locations or similar organisations are compared, there are (almost) always differences. The value of the benchmarking process lies in these differences when their causes are analysed.

Often only the (horizontal) comparison over different years is possible or desired, besides the (vertical) comparison over different plants. In order for these comparisons to succeed, annual data or plant data (in a vertical comparison) must be subjected to further **standardisation.** (See step 4)

This analysis of energy consumption is the source of knowledge, especially in energy management:

- Why do we consume more in spring than in autumn?
- Why does energy consumption increase despite constant production?
- Why does an identical system consume more for the same production?

The astonishment at the differences immediately leads to the question why what is going on in one plant or at one time is not also possible in other plants or at other times. The answers lead to insights that enable further optimisation and better energy planning.

b) Verification for the improvement of EP

The continuous improvement of EP is the central goal of an EnMS. Since the introduction of new accreditation regulations in the form of DIN ISO 50003:2016 for certification bodies, they now explicitly require examination of EP improvement in an ISO 50001 certification audit By carrying out the audit in accordance with ISO 50003 , the certification bodies are required to review the requirements for continuous EP improvement whilst carrying out ISO 50001 audits. EP is required to be proved as being traceable at all times and recorded in the audit reports as stated in the (re)certification procedure and also in the accreditation procedure. A good certifier therefore also secures its customers, especially when it comes to tax relief.

Successful verification is based on the following main points:

- Selection of suitable key figures
- Planned, performed and transparently documented measurements before and after implementation of the measures
- Reproducible standardisation and, if necessary, adjustment of the output bases
- Availability of all the above documented information

As mentioned in step 4, in EnMS, organisation-related and process- or plant-related key figures need to be established. The changes in energy output could be mapped using both types of indicators or their mix. The choice of method depends on local conditions: If there were hardly any changes in production facilities, order situation and building fabric compared to the previous year, the top-down approach is practicable and suitable - but this is rarely the case. As soon as significant innovations in plant equipment, shift system, pricing or the order situation have occurred, the top-down approach is more suitable due to the increasing complexity.

Irrespective of the method, the same energy consumption value or savings must be determined at the end if the design and data situation are correct. Companies are therefore free to switch between the methods or combine them, depending on location and time.

TIP: ISO 50047 addresses the issue of determining energy savings. Here, both methods for key figure formation are explained in detail and using examples (also for regression analyses).

Stage III – Starting a continuous improvement based on the true PDCA cycle

The systematic data collection of the first stage should help to find out whether there is some benefit to be gained from the energy supply and the main consumers. Reinforcing interest in energy consumption during the second stage of the implementation process opened up additional saving opportunities with the help of a more systematic approach to energy issues and their organisation. Activities particularly relevant to energy were subjected to fixed processes, the employees were involved, a systemic improvement management was set up and the first energy key figures were defined. This introduces all energy-relevant processes and elements of an EnMS. Top management can now decide how to proceed. Do you...

- ... return to Level I because the effort, benefits and possibilities of a more systematic approach are out of all proportion for your organisation
- ... simplify the rules established in Stage II and resubmit the documentation again or
- ... drive the savings of the previous work further and implement a complete EnMS, which means working out new goals and system adaptations for the future in a continuous improvement process?

If the top management decides to implement the processes and procedural documentation, it has reached the third stage of energy management. This starts a real PDCA cycle and introduces a complete EnMS according to the requirements of DIN EN ISO 50001.

The cycle for continuous improvement that has now been established can be based on the calendar year or fiscal year, but should not exceed 12 months. The procedures for regulating the processes are periodically implemented through regular monitoring of targets, interchange of information in all areas and the top management, carrying out energy team meetings, training of employees, etc.

Once a year, all data and facts collected are updated (in the energy report) and an internal energy audit is carried out (step 16). Finally, based on previous year's results, a review of the future strategy and the goals to be achieved is conducted with top management before the routine processes for implementing the goals and improvements are finally resumed.

Once the first energy report is entered into EnMS and a first internal audit cycle has begun, nothing stands in the way of external auditing and certification according to ISO 50001!

Step 15: Application of Organisation and Communication (Do)

After the introduction of comprehensive procedures for the operation of an EnMS, critically, the last stage is that they be applied to daily work.

The regular pursuit of goals as well as corrective and improvement measures is of the utmost importance. This can take place, for example, through regular (at least quarterly) energy team meetings during which information from all areas is exchanged (see step 12).

After the initial information in step 11, the employees may need further training in order to become familiar with the particularly energy-relevant processes and to apply them with maximum savings. Energy management representatives will get suggestions for their work in specialist seminars and lectures and pass them on internally, etc. 10.1 10.2

Now at the last, regular **energy control** will begin during the year. Based on the historical data of the energy report (the first energy consumption analysis), in conjunction with the current data and key figures, it enables those responsible to monitor and control the effectiveness of the EnMS via consumption. 9.1

If "deviations" from target planning or new consumption details become known, these form a basis for further continuous improvement of planning energy use, key figures or new energy targets. Actions to involve all employees lead to further energy-relevant suggestions that supplement the catalogue of improvement measures.

Step 15 is not a work package to be ticked off, but the beginning of an ongoing process that is constantly being followed up, improved and supplemented by all those involved.

Step 16: Updating the energy analysis, internal energy audits (check)

The first part of the obligatory annual self-check in the PDCA cycle is the **energy analysis.** Ongoing energy control does not replace the detailed collection of all relevant data and facts at least once a year and the updating of (external) information (development of energy prices, future legal regulations, new economical processes, current parameters from benchmarking etc.). If the energy analysis was summarized as an energy report, it is updated with the current values at the end of a year under review (see step 4). At least the following should be considered:

- Evaluation of current and planned energy consumption
- Analysis and selection of the main energy input ranges, relevant variables, static factors, key figures, output bases (including adjustment and standardisation if necessary)
- Implementation of an energy data collection plan and individual action plans
- Review of the effectiveness of action plans
- Determination of further measures for energy optimisation

The updated energy analysis is again the basis for the revision of the planning energy use for the next period and the basis for the internal audit. It serves the Top management in the review to monitor success.

The second part is the **internal audit** (3.3.8) of all relevant areas. It is one of the core elements of any management system. With the participation of as many departments and employees as possible, the current technological and economic energy situation is recorded. The process and the audit programme must therefore be planned and documented (see also step 8). 9.2

The internal audit plan shall take into account the energy consumption significance of the areas to be audited.. Within a three-year cycle, each area that influences or participates in energy consumption must be audited internally at least once. It makes sense to include energy-consuming systems, particularly for conversion into other forms of energy (electricity, heat, compressed air generation), in the internal audit on an annual basis. Only areas with low consumption may be taken into account once every three years.

Internal audits can be conducted throughout the year (especially in large organisations). Often they take place within a certain timeframe in order to determine the current status of the energy situation as well as that of energy management in place and are carried out in addition to the energy analysis before the review process. The results of these internal audits are evaluated during the review and this evaluation forms the basis for further planning.

To prepare the internal energy audits, the auditors (the audit team) should receive up-to-date information (figures, data, facts = ZDF) before the visit of an area in order to use this as a basis, e.g. to clarify the cause of changes. After the internal audit, the energy analysis (the energy report) is corrected or supplemented with the current results. Already in this phase the plausibility of the influencing factors (see also energy data acquisition plan) and the changes of output bases for the essential consumers should be checked.

Furthermore, the auditors should know the improvement measures and goals that may need to be implemented before visiting the plants or in the areas in order to check their current status. The internal audit usually has four objectives in management systems:

- **System audit:** Examination of the integration of standards to be observed in the MS (strongly decreasing importance with increasing age of the MS)
- **Function audit:** checking the implementation of internally defined processes and target tracking, checking the processes for quality assurance of data collection, determining the causes of deviations and determining the need for correction on the part of users or in the system (if there is room for improvement)
- **Compliance Audit:** Verification of compliance with applicable legal requirements and voluntary commitments. (This check can be carried out in parallel with the system and function audit, but the procedure and the result must be described separately in the audit report) (ISO 50001, 9.2)
- **Ongoing improvement:** Discover further saving potentials from discussions and suggestions of employees, from on-site inspections and joint analysis of current data and facts.

An internal energy audit carried out by energy experts offers the opportunity for further insights based on previous information. The considerations and discussions with employees often give rise to new or additional suggestions for potential savings. In addition to meeting the standard requirements, an audit should also have added value for the company and uncover new possibilities for improving energy efficiency. Since the internal audits must take place at regular intervals, this means that an improvement of the EP can also be proven regularly in the form of internal audit reports and is therefore comprehensible for third parties.

If another management system already exists (QM, EM, OHSAS, ISMS), the energy audit can be part of a more comprehensive internal audit that includes, for example, environmental or quality management. As in other management systems, energy auditors should have knowledge of the standard the audit is based on, energy distribution and use techniques. In addition, they must be independent of the area to be audited in order to enable an "external view" in the internal audit as well. If required, external energy experts can also be involved.

There is rarely an opportunity to examine a topic in an organisation as comprehensively as is carried out by an audit team. The results of the energy audit are therefore an important information basis for the review. Therefore, the audit manager should provide a summary of the results. Part of the audit report should also include a list of potential improvements, which can then be incorporated into the improvement measures plan.

Tip for SMEs:

Form an audit team consisting of a person from the company who knows the management regulations and concentrates on them during the audit and an external expert, e.g. an energy consultant, for whose use there are often subsidies. In this way, further savings potential can be identified in the internal energy audit and the required objectivity is maintained.

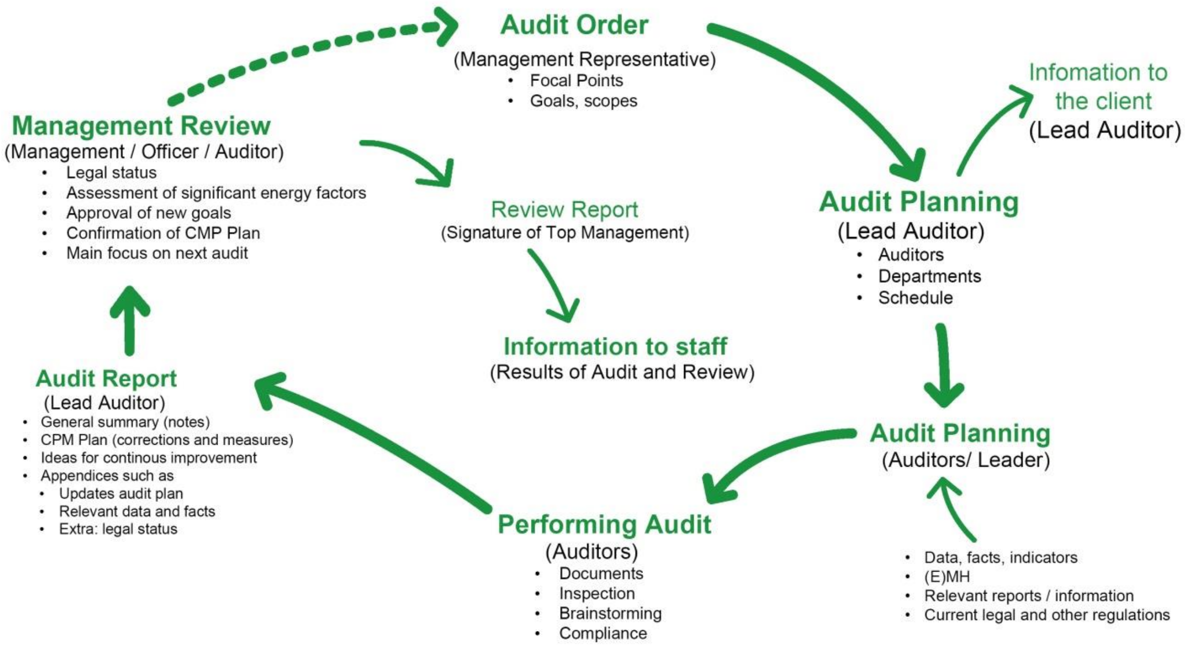


Figure 16: Internal audit procedure

Step 17: Annual update of action plans (Plan I)

The results from the first stage, as well as an energy saving programme as a central focus and the **energy action plans** derived from it have already been adopted. 6.2.3 9.1

So Implementation can be regularly reviewed during meetings within the organisation. After updating the figures, data and facts, or analysing details such as load profiles, so there are always opportunities for savings and if they are specified in preparation for the review, they can supplement the list of objectives..

Suggestions for improvement are made by employees throughout the year and together with updated energy analysis, further energy efficiency potential concepts will arise. In addition to any necessary corrections, the internal audit should, above all, identify new savings potential ideas. In this way, an updated energy saving programme can be systematically developed (from new and updated targets), which is presented during the review and adopted in a binding way after discussion and, if necessary, supplementation by Top management.

Note: Creation of an energy saving program

It becomes clear that the PDCA cycle is not to be understood as a stubborn sequence of system blocks, but consists of elements that can partially run in parallel and interlocked fashion in the improvement cycle. This is illustrated by an overview of the energy saving programme and the detailed action plans (to be described and defined in step 8).

Step 18: Management review (Act to Plan II)

9.3

The effectiveness and appropriateness of the EnMS must be reviewed at regular intervals by Top management. Right from the start, the energy policy leadership committed itself to the continuous improvement and systematic monitoring of the PDCA cycle.

The review is always held at the end of the old cycle and at the same time the starting point of the new cycle. It always combines the important elements "Act" and "Plan" of the improvement cycle. It makes sense to involve all personnel entrusted with significant energy-relevant functions in the review. It is important that the review is documented in the form of decisions on all agenda items. This is derived from the hierarchy of the system elements:

- At the beginning the context is evaluated by the review: Have the relevant internal and external topics (in comparison to the previous year) remained the same or have there been changes? This means that the results of the analysis must be evaluated in order to make a statement on the status of the current situation relating to risks and opportunities. (Act/ Plan)
- The energy policy and legal conformity are checked and evaluated within the framework of the EnMS for their topicality. If necessary, the policy must be adapted or, immediate measures taken to establish legal conformity. (Act/Do)
- All technically relevant information about EP is discussed and evaluated (Act/ Plan) within the energy report. Only at this stage can a final decision be made on possible energy saving targets and a new energy saving programme adopted. The energy targets now form the basis of the updated energy use plan. (plan)
- The continuous improvement of the EnMS also includes the improvement measures (corrective and improvement measures) pursued throughout the year. Their status should also be discussed and confirmation of timely implementation should be part of review decisions. (Act)

The energy review is logged and should be made available with the accompanying information documents (see above) at least to personnel entrusted with energy-relevant functions.

In principle, the management review process is similar to reviews carried out for other management systems and - like the internal audit - can be integrated into the reviews of other standards such as quality or environmental management.

The energy review input data and decisions form the basis of the new cycle of energy efficiency continuous improvement that is now beginning.

Welcome to systematic energy management!

You have now taken all the necessary steps to manage the efficient use of energy. You have repeatedly made decisions to continue on the basis of the path you have travelled and the success you have achieved. In particular by implementing the steps of stages II and III, a systematic structure has been created which has set a cycle of continuous improvement in motion.

Should we have aroused your interest with this practical guide, we will of course continue to be there for you and will be happy to make you corresponding offers.

To deepen your knowledge around the optimisation of energy management systems, the GUTcert Academy offers numerous advanced training courses for all levels of knowledge from beginners to experts. Many courses are available in-house and online, so that even large groups of employees can be trained flexibly and efficiently.

You can find the current range of training courses at www.gut-cert.de/akademie.html.

The GUTcert team wishes you much success, especially in saving energy and money and improving your environmental performance!

If you have any questions, please contact us.

Your GUTcert energy team

GUTcert
Eichenstraße 3b
12435 Berlin

030 2332021-0
https://www.gut-cert.de

Annex I – HLS as the basic structure of ISO standards

The new ISO 50001:2018 is based on a so-called "High Level Structure" (HLS). This has been mandatory for all new and revised ISO standards for management systems since 2012. Thanks to the uniform structure and the definition of cross-standard terms, HLS creates a solid basis for integrating various management systems in an organisation into a comprehensive integrated management system.

Introduction

1. Scope

2. Normative references

3. Terms and definitions

4. Context of the organization
- 4.1 Understanding the organization and its context
- 4.2 Understanding the needs and expectations of interested parties
- 4.3 Determining the scope of the XXX management system
- 4.4 XXX management system

5. Leadership
- 5.1 Leadership and commitment
- 5.2 Policy
- 5.3 Organizational roles, responsibilities and authorities

6. Planning
- 6.1 Actions to address risks and opportunities
- 6.2 XXX objectives and planning to achieve them

7. Support
- 7.1 Resources
- 7.2 Competence
- 7.3 Awareness
- 7.4 Communication
- 7.5 Documented information
  - 7.5.1 General
  - 7.5.2 Creating and updating
  - 7.5.3 Control of documented information

8. Operation
- 8.1 Operational planning and control

9. Performance evaluation
- 9.1 Monitoring, measurement, analysis and evaluation
- 9.2 Internal audit
- 9.3 Management review

10. Improvement
- 10.1 Nonconformity and corrective action
- 10.2 Continual improvement

This is the basic HLS layout. Since 2012 it serves as a mandatory framework for new and reworked certification standards.

XXX indicates the specific theme, such as quality, energy, work safety or environment.

Figure 17: Overview of the HLS

By integrating energy management into other existing management systems (EMS, QMS, ISMS), external audit times and thus also costs are reduced in addition to internal effort.

The new HLS is accompanied by considerable changes or shifts in content within the chapters. Chapter 4 of ISO 50001:2011 is particularly affected, and the following diagram shows where the contents of the new standard are located.

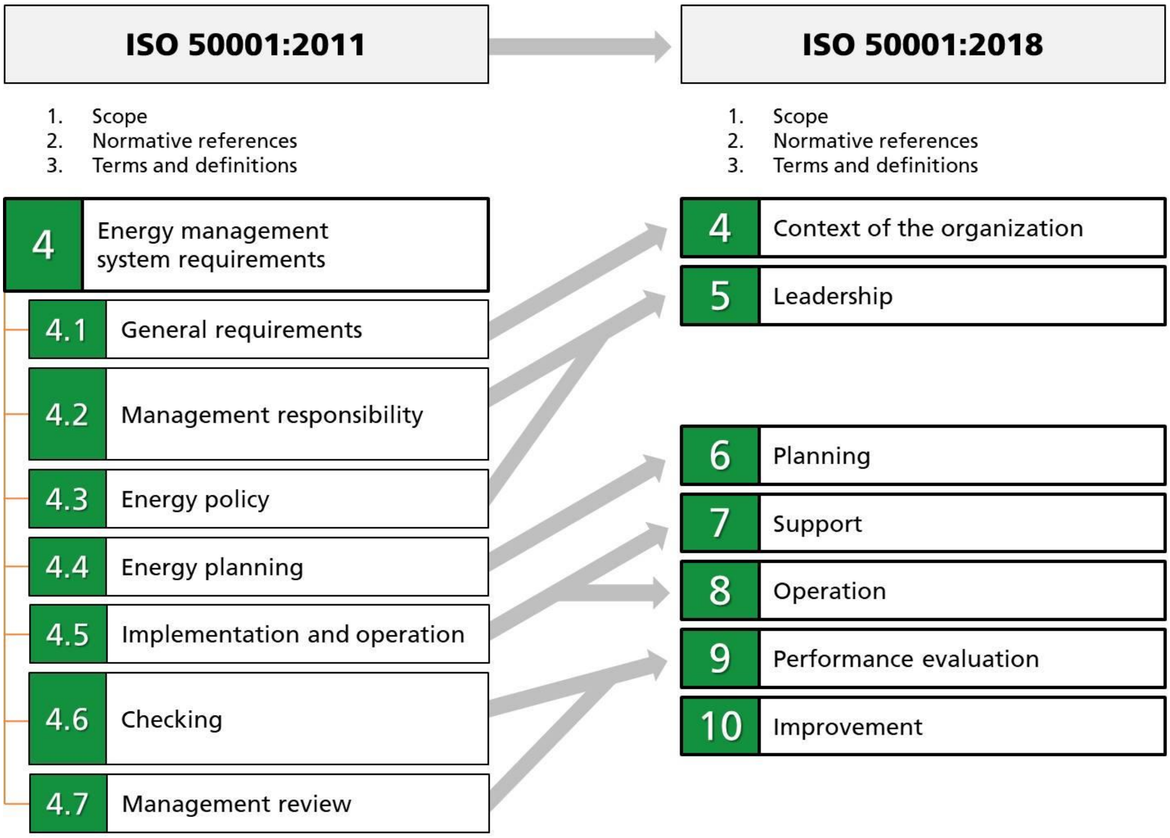


Figure 18: ISO 50001:2011 versus ISO 50001:2018

Annex II – Possible content of Energy Action Plans

Energy saving projects shall be described in detail in action plans to ensure that third parties can verify the improvement. The following table of contents gives an overview of what information should be included in an action plan and what considerations should be documented. A link to the respective destination in the energy saving programme is a good idea. Action plans should be made for a savings project and should be approved by the top management as part of the management evaluation. Documentation should be appropriate to the complexity of the project and the investment costs.

Action Plan No. 001

1. Preliminary remarks/ Description of the savings project
2. Energy consumption in the reference year/ Classification by energy source
3. System description, balance limits, current status, influencing factors, including starting point for M&V
4. Planned measure(s) to optimise the savings project
   4.1. interrelations
   4.2. M&V design/ budget taking into account the influencing factors
5. Investments, savings value
   5.1. Provision of costs/ cost centres
   5.2. Avoided CO_2 emissions , further advantages if necessary
6. economic efficiency calculation
   Verification Methodology
7. Implementation timeframe and sequence Responsibilities, workload
   7.1. Loss of work and production
   7.2. Responsible for implementation (project management)
8. Annexes/ Other

Example: List of Figures

Figure 1: Definition of system limits
Figure 2: Measuring points
Figure 3: Material and energy flows in the current production process
Figure 4: Material and energy flows according to planned measures

Example: List of Tables

Table 1: Energy review of the ACTUAL state
Table 2: Energy consideration of target state
Table 3: Cost analysis of the planned new investment
Table 4: Discounting of annual energy cost savings

Approval:

__________________ ______________________________

Date Signature of the Management Board

Notes

____:

implementation:

__________________ ______________________________

Date Signature of the Management Board

Notes ____
______________________________:

The GUTcert - Who are we?

GUTcert is an internationally recognized company for the testing of

- management systems
- produce
- staff
- vendors

and offers knowledge transfer in these areas.

As part of the AFNOR network, GUTcert has access to more than 1,800 auditors from over 90 countries worldwide and is increasingly active internationally.

DAkkS Deutsche Akkreditierungsstelle

Certifications

ISO 9001
ISO 14001
BS OHSAS / ISO 45001
AZAV
ISO 22000 (-FSSC)
ISO 27001 / ITSK
ISO 50001
Testation acc. to SpaEfV:
Alternative Systems
Energy Audit according to DIN EN 16247

In conjunction with **AFNOR** et al
ISO TS 22163 (IRIS Rev. 03)
IATF 16949
AS 9100

and **EMAS** according to **DAU**

DAkkS Deutsche Akkreditierungsstelle

Verifications

Emission reports (ETS)
Carbon Footprint acc. to ISO 14064

Evaluations

ISCC / REDcert / RSPO
EEG 2009 / 2012 / 2014 / 2017
Biomethane injection
Guarantees of origin (HkN)

Certified waste management

Privacy Policy

Asset Management ISO 55001

State of sustainable development (DNK and GRI)

Berlin Cert is a **Notified body**
for guideline 93/42/EWG
Systems (annexes II, V, VI)
Products (annex IV)

DAkkS Deutsche Akkreditierungsstelle
Certification body
for ISO 13485

Testing laboratory for medical products

GUTcert Akademie

UM / QM / EnMS / ISMS u.a.
Auditor's and manager's trainings

Inhouse courses

Customized e-Learnings

The GUTcert Academy bundles the expertise of auditors and other experts in compact further training courses. Participants at all levels of knowledge are given the necessary skills to reliably understand and meet standard requirements in day-to-day operations.

You would like to take responsibility for your organisation's management systems or act as an auditor for certification bodies? No problem, our courses prepare you practically for your tasks and meet current training requirements.

The further education offer covers the entire range of GUTcert services. In addition to the established management standards (ISO 9001, ISO 14001, ISO 27001, ISO 45001 and ISO 50001) we also train you on topics such as sustainability, emissions trading, AZAV, EEG and RSPO.

EnMS Guide international

German (V 5)

French (V 4.2)

Spanish (V 4.2)

Mandarin (V 4.2)

Polish (V 4.2)

Russian (V 3.0)

Bulgarian (V 3.0)